Series 1931 Number 1

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Survey

of

Dundy County, Nebraska

By

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Bureau of Chemistry and Soils

In cooperation with the University of Nebraska State Soil Survey
Department of the Conservation and Survey Division

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SOIL SURVEY OF DUNDY COUNTY, NEBRASKA

By E. A. NIESCHMIDT, in Charge, and B. J. ABASHKIN, Nebraska Soil Survey, and F. A. HAYES and S. RANKIN BACON, United States Department of Agriculture

COUNTY SURVEYED

Dundy County is in the southwest corner of Nebraska (fig. 1). Benkelman, the county seat, is about 200 miles by rail northeast of Denver, Colo. The county is rectangular, its approximate dimensions being 38½ miles from east to west and 24 miles from north to south. It covers a total area of 920 square miles, or 588,800 acres.

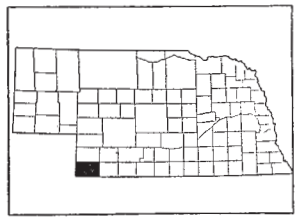

FIGURE 1.—Sketch map showing location of Dundy County, Nebr.

The county includes parts of two major physiographic regions of Nebraska — a smooth eastwardly sloping plain occupying approximately the eastern third of the county and most of the area south of Republican River in the south-central and southwestern parts and a valley plain which occupies the remainder. The former is underlain by a thick loess deposit and the latter by sand, which by being blown into dunes produces a rolling surface relief. The boundary between these regions is sharply defined in the northern part of the county, but in the southern part it is rather indefinite. Disconnected areas of both regions occur scattered throughout the uplands in many places.

The rolling-plain region is a large outlier of the sand-hill region that covers north-central Nebraska. Its surface features are largely the result of wind action on loose sand and consist of a succession of rounded and irregularly distributed hills and ridges ranging from 10 to 100 feet in height, in a few places capped by drifting sand and pitted by blow-outs. The billowy surface is relieved at frequent intervals by nearly level or gently undulating valleys and basins of different sizes, many of which include excellent farming and hay land. In this region drainage channels are not established, except in a few valleys which extend into the sandy land from Republican River. The outlets of most of the valleys and basins are obstructed by sand dunes, and most of the surplus surface moisture escapes through the porous substratum. However, several marshy areas and a few small shallow lakes are scattered throughout the sandy land in the northwestern part of the county.

The smooth plain is part of a loess-mantled constructional plain which occupies most of eastern and central Nebraska and which at one time extended farther west. That part in Dundy County ranges from nearly level to extremely rough and broken, depending on the severity of erosion to which it has been subjected. In the northeastern part of the county the surface of the loess mantle has been slightly

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altered and lies near that of the old constructional plain. It is nearly level, although modified here and there by small shallow depressions locally known as " buffalo wallows " or " lagoons." Similar surface conditions prevail over several square miles of the loessial uplands in the southeastern part of the county, and numerous nearly level or rolling loessial areas, lying somewhat below the general level of the old plain, occur in the sand-hill region northwest of Benkelman.

The remainder of the loessial uplands in Dundy County has been severely eroded by Republican River and its tributaries. This river has carved a broad east-west valley across the southern part of the county and is entrenched from 200 to 300 feet below the general level of the uneroded loess-covered plain. In the south-central and southwestern parts practically all the loessial mantle has been removed on the north side of Republican River, and the sand-hill region extends to the river valley in most places. On the south side of the stream the loessial covering is generally intact, but the land has been carved by tributary drainageways into a series of sharp ridges separated by narrow steep-sided valleys, thereby presenting an extremely rough and broken appearance. Similar surface conditions prevail in the southeastern part of the county on both sides of Republican River, especially around the edges of the uneroded plain remnants, where the tableland gives way to the valley slopes. All the Republican River tributaries which have become entrenched in the loess-covered plain are characterized by narrow steep-sided valleys.

Alluvial lands, which include the terraces and flood plains along the larger streams, occupy about 5 percent of the total land area of Dundy County. The largest developments are along Republican River, where they occur as continuous strips having an average width of about 1 mile. Strips in few places exceeding one half mile in width occur along Arikaree River and Indian Creek. The alluvial lands along the other streams are in few places more than a quarter of a mile wide.

The terraces are more extensive than the flood plains. They lie from 10 to 30 feet above the normal level of the streams and are not subject to overflow from the main channels. They are nearly level or very gently undulating, except where the terrace material is composed largely of incoherent sand, in which wind action has produced a strongly undulating or rather hummocky surface.

The flood plains of Dundy County are broadest along Republican River where they occur as a continuous strip from one fourth to one half mile wide. Narrow strips also border Arikaree River and several of the larger creeks. The flood plains occupy the lowest valley levels and are subject to overflow during flood stages of the streams. Their surfaces are nearly level, modified in places by old and present stream channels, cut-offs, slight elevations, and shallow depressions.

The average elevation of the county is about 3,350 feet above sea level. The elevation ranges from approximately 2,870 feet where Republican River crosses the eastern boundary to about 3,500 feet throughout the uplands in the northwestern part. The elevation [1]

[1] GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U.S. Geol. Survey Bul. 274, Ed. 4, 1,072 p. 1906.

of Max is 2,889 feet; of Benkelman, 2,971 feet; of Parks, 3,105 feet; and of Haigler, 3,261 feet. The general slope of the county is downward toward the east.

Drainage is effected through Republican River and its tributaries, of which Arikaree River is the largest. These rivers are permanent streams. The larger creeks, including Buffalo, Rock, Horse, Spring, Indian, and Muddy Creeks, also flow permanently, especially in their lower courses, but most of the remaining drainageways are intermittent. The greater part of the county is well drained. However, small scattered depressions in the more nearly level parts of the smooth upland plain, a few basins in Champion Valley, and some areas in the lower lying parts of several sandy valleys in the northwestern part of the county are poorly drained. Local marshy areas also occur in the bottom lands along the rivers and larger creeks.

All the streams have rather steep gradients and are actively deepening their channels. Most of the drainageways in the eastern part of the county are widening their valleys in their lower courses and are extending their channels through headward erosion into the loessial uplands.

Well water of good quality is readily obtained in most sections. However, in many places, it is difficult to obtain a sufficient supply of good water on the valley slopes and in some of the more severely eroded parts of the uplands south of Republican River. The difficulty in these localities is owing largely to the impervious Pierre shale formation which is exposed or lies at a slight depth in the more eroded areas and which contains a negligible quantity of rather alkaline water. This formation underlies the entire county but, except in the areas mentioned, is beneath tertiary water-bearing sands and gravels, and it assists in preventing water loss from the tertiary deposits. It has no effect on the quality of the water, except in wells which extend into it. Throughout the greater part of the uplands well water is obtained from the tertiary sands and gravels, and the wells range from 75 to about 250 feet in depth. Water in the alluvial lands is obtained at a depth ranging from 10 to 40 feet. Most of it is of good quality, but that along the outer edge of the Republican River flood plains near the Pierre shale slopes is unsatisfactory in places.

Springs are numerous and supply much water for domestic purposes. Most of them are on the northern slope of the Republican Valley, and, along creeks in the sandy lands north of Republican River, they issue from the contact of the Pierre and tertiary formations.

Native broad-leaved trees, principally willow, ash, elm, boxelder, hackberry, and cottonwood, grow in narrow strips along the rivers and a few of the larger creeks. The trees are not used for lumber, but they are of local value for posts and fuel.

Dundy County was established and organized from unorganized territory in 1873, and its boundaries have remained unchanged. Most of the early settlers came from eastern Nebraska, Iowa, Illinois, Missouri, and more eastern States.

According to the Federal census, Dundy County had 5,610 inhabitants in 1930, all classed as rural. The density of the population is 6.1 persons to the square mile. Settlement is densest on the loessial

tablelands in the northeastern and southeastern parts of the county and in the valleys of the larger streams. The sand hill region is rather sparsely settled.

Benkelman, the county seat and largest village, located in the southeastern part of the county, had a population of 1,154 in 1930. This and the other villages and hamlets, including Haigler, Max, Parks, and Sanborn, ranking in size in the order named, are all in the Republican River Valley. They are the chief distributing points for farm implements, supplies, and produce.

Transportation facilities are fair. A main line of the Chicago, Burlington & Quincy Railroad and a gravel-surfaced State highway follow the Republican Valley across the southern part of the county, furnishing good connections with outside points. The county roads are of earth construction. Most of them follow section lines, except in the rougher areas where they conform to the topography. Good roads are rather scarce throughout the sand-hill region, on account of the expense involved in maintaining a satisfactory road surface on the unstable sandy materials.

The public-school system is well developed, except in parts of the sand-hill region where schools are rather scarce. The county has 63 school districts. Telephones are in common use, and mail routes reach nearly all sections.

CLIMATE

The climate of Dundy County, which is typical of the high-plains region, is characterized by rather wide seasonal variations. The winters are somewhat long and cold, and the summers are short and hot. The spring usually is short and cool, and the fall is long, with moderate temperatures. The rainfall and humidity are rather low, and the rate of evaporation is high. There is not sufficient variation in surface relief to cause any pronounced differences in climatic conditions.

The amount and distribution of the precipitation in any particular year is of vital importance in determining crop yields during that year. The mean annual precipitation only slightly exceeds the minimum required for profitable farming even in normal years, when about 80 percent of the moisture falls during the principal part of the growing season—April to September, inclusive. In years when the precipitation is below the mean annual or is unfavorably distributed, crops suffer greatly from drought. According to observations of pioneer settlers, crop yields were reduced 50 percent or more below the average by drought, during 10 of the 46 years, 1885 to 1931, inclusive, and during the same period yields were seriously reduced in 3 additional years by hail.

The precipitation occurs mainly in the form of local showers. It is usually well distributed in May and June, but in July and August the distribution is less favorable and periods of drought often occur in these months. The driest months are from November to March, inclusive, each with less than 1 inch of precipitation. The annual snowfall varies from a few inches to several feet, averaging about 2 feet.

The average date of the last killing frost at Benkelman is April 27 and that of the first is September 30. This gives an average frost-free season of 156 days, which is ample for the maturing of all crops commonly grown. Killing frost has been recorded as late as May 27 and as early as September 7.

In winter the prevailing winds are from the northwest and in summer from the south and southeast. Strong winds are common, but no tornadoes have been recorded.

Tables 1 and 2, compiled from records of the United States Weather Bureau stations at Benkelman and Haigler, give the normal monthly, seasonal, and annual temperature and precipitation at these towns.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Benkelman, Dundy County, Nebr.*

[Elevation, 2,968 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1901)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	28.5	75	−22	0.59	0.25	0.80	4.9
January	27.6	78	−24	.27	.10	.10	2.6
February	29.1	74	−23	.67	.20	.40	5.6
Winter	28.4	78	−24	1.53	.55	1.30	13.1
March	38.1	90	−8	.88	.04	4.25	6.4
April	50.9	98	12	2.06	.76	3.05	1.9
May	61.6	102	29	2.90	2.44	1.25	.5
Spring	50.2	102	−8	5.84	3.24	8.55	8.8
June	69.5	109	41	3.17	1.85	6.27	0
July	75.9	111	40	3.04	.52	1.30	0
August	75.2	108	37	2.67	2.80	4.95	0
Summer	73.5	111	37	8.88	5.17	12.52	0
September	63.6	102	30	1.72	1.16	8.70	(1)
October	52.8	93	16	1.25	.00	.45	1.1
November	36.6	85	−8	.55	.03	.15	2.5
Fall	51.0	102	−8	3.52	1.19	9.30	3.6
Year	50.8	111	−24	19.77	10.15	31.67	25.5

[1] Trace.

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation at Haigler, Dundy County, Nebr.*

[Elevation, 3,258 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1894)	Total amount for the wettest year (1915)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	22.4	68	−15	0.38	0.02	0.50	4.0
January	26.3	71	−22	.19	.40	.35	1.6
February	37.0	75	−17	.45	.92	.70	4.0
Winter	28.6	75	−22	1.02	1.34	1.55	9.6
March	34.8	85	−3	.67	.20	1.60	4.9
April	53.4	92	9	1.87	[1]	5.48	2.4
May	63.9	101	20	2.88	[1]	7.61	.4
Spring	50.7	101	−3	5.42	.20	14.69	7.7
June	69.4	107	39	2.93	3.44	2.98	0
July	80.4	107	48	2.69	1.60	2.72	0
August	76.0	108	38	2.40	.93	4.02	0
Summer	75.3	108	38	8.02	5.97	9.72	0
September	65.5	100	18	1.25	[1]	1.40	[1]
October	49.6	93	18	1.08	.18	2.50	1.1
November	41.7	87	−8	.45	.10	.35	2.6
Fall	52.3	100	−8	2.78	.28	4.25	3.7
Year	51.7	108	−22	17.24	7.79	30.21	21.0

[1] Trace.

AGRICULTURE

The first white people to utilize the agricultural resources of the area now included in Dundy County were cattlemen. During the sixties, great herds of Texas cattle were annually driven into western Nebraska for shipment from Ogallala, Nebr., which at that time was the end of the railroad and was also known as the "End of the Texas Trail." This trail crossed Republican River Valley a few miles east of the present site of Haigler, and the cattle herds were usually allowed to graze for several days on the luxuriant valley grasses before proceeding northward over the uplands to Ogallala. The abundance of feed and water along Republican River and its tributaries, together with the shelter for cattle afforded by numerous canyons in the adjoining loessial uplands, favored more permanent use of the land for cattle raising, and in 1872 a cattle ranch was located in the Republican Valley near the present site of Haigler. During the following years more ranches were established, and a few cattlemen soon controlled most of the valley and adjoining uplands. Cattle losses were heavy at times, owing to severe winter weather, but the range was free, the profit on the animals that survived was large, and cattle raising was very profitable.

In 1882, the Burlington & Missouri River Railroad was built across the county, followed by a great influx of settlers who established themselves on the better farming lands under the Homestead, Timber Claim, and Preemption Acts. By 1890, the valley lands and the more nearly level loessial uplands were included in farms, and most of the cattlemen were forced to move farther west. However, most

of the sandy land in the western part of the county is still used for grazing purposes.

The early farmers experienced hardships. The severe winters of 1885 and 1888 caused the death of large numbers of cattle and sheep. The summers of 1887, 1890, 1893, and 1894 were very dry and resulted in partial, in some places total, crop failures. In 1895, dry weather and grasshoppers ruined most of the crops, and the farmers were so impoverished and discouraged that they left the county in large numbers. The Federal census of 1900 shows about half the population recorded in 1890. Resettlement of the county was hastened by the passage of the Kincaid Act in 1905, increasing the size of homesteads available under the public land laws to 640 acres, thus making it profitable to take up land valuable chiefly for pasture. Since that time the progress of agricultural development has been steady. By 1910, more than 80 percent of the county was included in farms and small ranches, and now only a small proportion of the original public domain remains unclaimed.

The Federal census reports the value of all crops produced in Dundy County in 1929 as $2,666,104. Dairy products, excluding those used for home consumption, were produced to the value of $108,993 and poultry to the value of $81,179. The total value of all domestic animals on farms in the county was $1,897,264 on April 1, 1930.

According to the Federal census, 337,201 acres, or about 57 percent of the county, is in pasture land, and 189,243 acres, or about 32 percent, is under cultivation. Of the cultivated crops, corn is by far the most important. Wheat, wild hay, alfalfa, barley, rye, and oats rank in acreage, during most years, in the order named. Minor crops include potatoes, sweetclover, millet, sorgo, sugar beets, garden vegetables, and fruits.

Table 3, compiled from Federal census data, gives the acreage and production of the principal crops in Dundy County in stated years.

TABLE 3.—*Acreage and production of principal crops in Dundy County, Nebr., in stated years*

Crop	1889		1899		1909		1919		1929	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn [1]	29,107	428,438	20,672	216,600	61,190	661,747	68,021	1,059,666	119,311	2,925,548
Wheat	3,855	48,177	3,218	14,280	6,142	58,976	25,446	468,291	23,406	371,861
Barley	307	7,615	4	60	6,474	111,759	2,505	45,186	4,192	89,060
Rye	1,652	18,562	222	810	501	4,034	4,389	35,753	1,954	18,107
Oats	3,350	70,245	58	1,000	901	16,217	195	5,893	1,290	34,862
Potatoes	924	55,243	145	6,081	359	11,918	[2] 295	[2] 32,245	[3] 219	[3] 20,805
		Tons		*Tons*		*Tons*		*Tons*		*Tons*
Hay (all kinds)	9,173	11,180	9,622	12,644	20,687	17,217	21,768	22,351	20,353	22,628
Hay (all tame or cultivated grasses)			4,014	7,037	4,504	6,295	5,359	10,482	7,304	12,982
Wild hay			5,591	5,579	15,907	10,724	15,419	11,203	12,731	9,310
Alfalfa			3,117	5,942	1,834	3,704	4,258	9,200	4,954	9,507
Sweetclover									[3] 1,816	
Grains cut green			17	28	276	198	972	640	275	291
Coarse forage			1,768	2,394	7,318	10,346	11,475	18,926		
Sugar beets					8	79	101	1,017	219	3,237
	Trees	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*
Apples [4]	2		607	14	2,255	894	1,616	2,169	1,295	1,990
Peaches [4]			101		1,622	188	1,754	705	938	438
Pears [4]			4		62	1	55	13	142	87
Plums [4]	6	1	11,577	1,955	3,182	140	1,646	109	728	211
Cherries [4]	30	1	161	3	2,380	92	1,874	870	1,482	795

[1] Harvested for grain only.
[2] Data from 1920 Nebraska agricultural statistics.
[3] Data from 1930 Nebraska agricultural statistics.
[4] Trees of bearing age only.

Average crop yields over long periods are fairly uniform, but the yields by years vary considerably, depending on variations in the amount and distribution of the precipitation and in the length of the growing season.

Table 4, compiled from the Nebraska agricultural statistics, shows the average acre yields of the leading crops during the period 1925–29, inclusive, and the acre yield and the approximate percentage of the total area of the county devoted to each crop in 1930.

TABLE 4.—*Average acre yield of principal crops in Dundy County, Nebr., in stated periods and percentage of county occupied by each crop in 1930*

Crop	Average acre yield in—		Approximate percentage of county occupied by crop in 1930
	1925–29	1930	
	Bushels	*Bushels*	*Percent*
Corn	19.6	30	20.1
Winter wheat	14.4	20	4.0
Barley	22.4	30	.7
Rye	10.2	14	.3
Oats	27.0	32	.2
	Tons	*Tons*	
Wild hay	0.96	1.1	2.2
Alfalfa hay	2.68	3.2	.8
All other hay	----------	1.4	.5
Sweetclover	----------	----------	.3

The returns derived from livestock are an important source of revenue. According to the Federal census, the value of livestock and their products was about four fifths of that of all farm crops in 1929.

Table 5, compiled from the Federal census reports, gives the number and value of domestic animals and poultry on farms in the county in 1900, 1910, 1920, and 1930.

TABLE 5.—*Number and value of livestock in Dundy County, Nebr., in 1900, 1910, 1920, and 1930*

Kind of livestock	1900		1910		1920		1930	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Cattle	20,112	----------	15,435	$355,115	25,039	$1,252,355	23,503	$1,182,859
Swine	7,390	----------	12,407	120,615	15,137	308,412	30,440	394,847
Horses	3,369	----------	6,230	577,255	7,723	476,171	6,041	254,878
Mules	217	----------	696	79,495	720	71,263	861	48,017
Sheep	8,229	----------	6	21	17	240	2,579	16,251
All poultry	33,618	$10,806	47,835	21,338	56,033	54,871	----------	[1] 81,179

[1] Value of poultry raised in 1929.

As a rule, the farm buildings are moderately good, and the barns and other outbuildings are large enough to house the crops. The farm improvements average better in the river valleys and throughout the loessial uplands than in the more sandy sections. The Nebraska agricultural statistics show that in 1930, 31 farmhouses had modern heating plants, 107 had running water, 65 were equipped with electricity, and 231 had radios. Most of the farms and ranches are

fenced and cross fenced, mainly with barbed wire. The work animals include heavy draft horses and mules, although the greater part of the farm work is performed with tractors. There were 188 gas tractors, 112 gas engines, 188 trucks, and 597 automobiles on the farms in 1930. The farm machinery is of the most modern and labor-saving types, including gang or sulky plows, disks, harrows, drills, listers, corn planters, binders, wagons, and complete equipment for harvesting hay. Many farmers have cream separators, and a few own wheat combines, corn shuckers, hay balers, and grain threshers. Only the more expensive machinery is kept under shelter.

The Federal census reports that 532,857 acres, or nearly 90 percent of the land area of the county, are included in 709 farms. The average size of farms is 751.6 acres. Most of the farms range in size from 260 to 1,000 acres, but there are a number of small holdings, also many ranches exceeding 1,000 acres.

In 1930 owners occupied 51.6 percent, tenants 46.4 percent, and managers 2 percent of the farms. About one third of the tenant farmers were related to the landowners. The proportion of tenant farms has greatly increased since 1880, when only 8.3 percent of the farms were operated by tenants.

On tenant farms both the share and cash rental systems are used. The share system was used on 86.2 percent of the farms in 1930. Under this system the owner receives one third of the grain and from 50 cents to $1.50 an acre for the pasture land. All seed, labor, and machinery are furnished by the tenant. When alfalfa land is rented on shares, the owner receives one half the hay stacked in the field. Under the cash system the tenant pays from $2 to $5 an acre, the higher rent being paid for irrigated land. Pasture land often is rented for a lump sum.

In general, farm laborers are plentiful, except during the small-grain harvest when good help is often scarce. Monthly farm wages in 1931 ranged from $20 to $30 with board and lodging, day labor was plentiful at $2 a day, corn shuckers received 2 or 3 cents a bushel, and wheat was threshed for 5 to 7 cents a bushel. A large part of the wheat is harvested with combines. Some of the farmers and many of the ranchmen hire help by the year.

According to the records from the office of the register of deeds, there were 51 land transfers[2] during the 12 months preceding March 31, 1931. These transfers involved 20,190 acres, or about 3½ percent of the total land area of the county. The average assessed value of the land in 1930 was $11.86 an acre. The selling price of individual farms ranges widely, depending on the character of the soil, topography, drainage, improvements, and location with respect to markets.

Grain production and livestock raising are the principal industries. Corn has been the leading crop since farming began, because it can be grown with comparative success on all soils suited to cultivation. Most of the corn is fed to livestock either on the farms where produced or on farms within the county. Tenant farmers as a rule sell most of their corn to local feeders. Wheat, which ranks next to corn in importance, is grown entirely as a cash crop. Practically all of it is sold in the local markets as soon as harvested and is shipped to Omaha or Chicago. A small amount of wheat is used in

[2] Transfers reciting family transactions not included.

a flour mill at Benkelman. Sugar beets and the surplus potatoes, both of which are minor crops, are also sold for cash, the sugar beets being purchased by Colorado sugar refiners and the potatoes by eastern Nebraska merchants. All the hay and small-grain crops, other than wheat, are fed to livestock within the county.

About two thirds of the land is used as native pasture and hay land in connection with the raising of cattle, which is the most important branch of the livestock industry. Most of the cattle are of good quality grade stock, and the herds are usually headed by a pure-bred bull. The principal breeds are Hereford and Shorthorn. Some of the ranchers purchase cattle for summer grazing, but most of the animals are raised locally. Many feeders annually purchase cattle for winter fattening. Most of the feeders operate farms in the valleys where alfalfa can be successfully grown. The cattle to be fattened are fed corn and alfalfa from 60 to 90 days and are then shipped to the Denver, Omaha, or Kansas City markets. The range cattle are fed principally on wild hay during the winter, although in severe weather some corn or rye is usually added to the ration.

Hog raising ranks next in importance among the livestock industries. Each farmer raises a few hogs, and a few maintain large herds. Many hogs are raised in connection with the feeding of beef cattle. Most of them are fed corn and alfalfa or sweetclover, although young pigs usually receive some rye, oats, or barley. All the hogs are of good breeding, and there are many pure-bred herds of Duroc-Jerseys, Poland Chinas, and Hampshires. Practically all the hogs are fattened on the farms where raised. The fattened animals, when marketed, range in weight from 180 to about 250 pounds. The lighter hogs are usually shipped to Colorado and California markets and the heavier ones to Omaha or Kansas City. Sanitary measures prevail in the hog-raising industry, and disease is generally kept well checked.

Dairy products are an important source of farm income. From 4 to 10 cows, chiefly of mixed beef and dairy breeding, are kept on the average farm. Most of the surplus dairy products are sold in local cream stations, from which they are shipped to creameries outside the county. A part of the cream is used in a cooperative creamery located in Benkelman.

A few dozen chickens are raised on most farms, and some farmers have flocks of several hundred. The principal breeds are Plymouth Rock and Leghorn. Poultry products are either sold or exchanged for farm supplies in the local towns. A few turkeys are raised in the sand-hill section, but in general turkey raising receives little attention.

Only a few sheep are raised. However, a few thousand are occasionally shipped in and fattened on corn and alfalfa, generally in years when pasturage is poor in Colorado and Wyoming.

Horse raising, which was formerly of considerable importance, has been practically abandoned. Most of the stallions have been sold or otherwise disposed of, and only a few colts were seen during the progress of the survey. As most of the farm work is done by tractors, few horses are kept.

Cropping methods and practices in Dundy County are similar to those of other western Nebraska counties.

Corn, the most important crop, is planted about the middle of May. A lister is ordinarily used, because a minimum of labor is required in preparing the land and because listed corn is thought by most farmers to be more drought resistant than that planted in checkrows. The corn is cultivated three or four times until early in July, after which it receives no further attention until harvest, except to remove the more obnoxious weeds by hoeing. The crop matures in September or early in October. The greater part is husked from the standing stalks, although many farmers annually fence off a few acres of unhusked corn for fattening hogs and cattle. Only early-maturing dent varieties of corn, which have become adapted to the local soil and climatic conditions, are grown.

Practically all the wheat grown is of the winter varieties, chiefly Kanred, Turkey, or selections of these. The land to be used for wheat is plowed and harrowed in late summer, and the seed is planted with a press drill in late September. The crop usually makes a good growth before killing frosts occur. It remains dormant during the winter, resumes growth in early spring, and usually matures early in July. It is either cut with a binder or header and later threshed, or it is harvested with a combine. The wheat yield is sometimes reduced by stinking smut which stunts and distorts the kernels and gives the grain an offensive odor. This form of smut may be controlled by mixing the seed with copper carbonate powder at the rate of 2 ounces of the powder to a bushel of grain.[3]

The farmers do not produce much barley, but the acreage devoted to this crop is increasing. Barley ranks next to corn, measured in terms of feed produced an acre. The crop is planted and harvested in the same manner as wheat, except that the land is prepared and the grain is sown in the spring instead of in the fall. Smooth-bearded varieties, such as Comfort and Glabron, are grown chiefly. Barley is a good substitute for corn, and a reasonable acreage is worth while to insure feed should unfavorable weather materially reduce corn yields.

Rye and oats are grown on a few farms. Most of the rye is produced on sandy and rather droughty soils where it does fairly well. The grain is planted either in the fall or spring in the same manner as wheat and is used chiefly for hog feed, although some farmers annually sow a few acres to rye for late fall pasture. Oats are grown chiefly on fine-textured silty soils. Most of the crop is used for horse feed.

Sugar beets are produced on a few irrigated farms in the bottom lands along Republican River. The land to be used for this crop is prepared by plowing and harrowing early in the spring, and the seed is planted with a drill early in May. When two or three leaves appear the crop is thinned. Weeds are usually removed by hoeing. When the beets mature they are pulled, topped, and hauled to the railroad in October or November. They are shipped to the sugar factories in Colorado.

Alfalfa occupies the largest acreage among the tame-hay and forage crops. Most of it is produced on the bottom-land soils, and part of it is grown under irrigation. The varieties grown are among

[3] STEWART, P. H., and GROSS, D. L. SMUT CONTROL IN CEREALS. Nebr. Agr. Col. Ext Circ. 132. 13 p. 1929.

the most hardy obtainable, including Common, Grimm, and Cossack, all of which are resistant to winter-killing. Thorough seed-bed preparation is important in obtaining a good stand. Early plowing, followed by sufficient disking, harrowing, and possibly rolling to control weed growth and to compact the soil is desirable in most places. The customary seeding rate is 15 pounds of good seed to the acre, but slightly more is used on the more sandy soils. Pure certified seed should be used. Alfalfa is usually allowed to remain as long as it yields profitably. A field is rarely frozen out. The crop is generally cut two or three times during the summer. The common practice is to stack the hay in the field and haul it to the feed lots as needed. Most of it is fed to cattle and hogs.

A few acres of sorgo are grown for forage on most farms. This crop is very productive, yielding from 1 to 5 tons an acre. It belongs to a group of plants that become temporarily dormant during dry periods, and it is very drought resistant. The best quality of feed is produced if the crop is cut when the heads begin to mature. Most of the sorgo is fed with corn and barley, and its feed value compares favorably with that of any of the wild hays. Black Amber, Sumac, and Early Orange are the most common varieties grown. Cattle and horses should not be allowed to feed on green sorgo, especially during periods of drought or immediately after early frosts, as at these times the plants contain unusually large quantities of prussic acid which is very injurious to livestock.

Sweetclover, although still a minor crop, is being more extensively grown each year. The plant is a biennial and dies at the end of the second year, after producing seed. It is used chiefly for pasture and to some extent for hay and seed. When hay is desired the crop is usually cut during the first year before the growth becomes coarse. In the second year, the crop may be allowed to mature and reseed itself or it may be cut with a binder and threshed for seed. The most common time of seeding is in early spring. The seed bed is prepared in a manner similar to that required for alfalfa, and the seed is usually sown broadcast and covered with a harrow. From 12 to 15 pounds of scarified seed an acre are ordinarily used on silty soils and from 18 to 22 pounds on sandy soils. The greater part of the crop is grown on rather sandy land. Sweetclover has an unusually wide adaptation. It thrives on either comparatively wet or dry soils and on soils of either heavy or light texture. It is a very valuable crop for soil improvement, many farmers considering it as valuable as alfalfa for this purpose. It is adapted to shorter rotations than alfalfa and will probably improve the productivity of the soil as fast as that crop. The roots are large and vigorous and decay rapidly after the end of the second year's growth. The crop is a good soil binder and is especially valuable on unstable sandy soils and on steep slopes where erosion is severe.

Much wild hay is cut in wet valleys and on the more nearly level areas throughout the sand-hill section. Some is also produced in the more poorly drained parts of the bottom lands along Republican River and on narrow canyon floors throughout the loess-covered part of the county. The greater part of the hay cut in the wet valleys and on the bottom lands consists of water-loving grasses and sedges and is rather coarse in texture, but that cut in well-drained situations is of excellent quality. The hay is usually stacked in the fields and

hauled to the feed lots as needed. It is fed chiefly to cattle and horses.

No definite system of crop rotation is practiced. On some farms corn or wheat has been grown continuously for 10 or more years on the same land. Corn is usually grown 3 or 4 years, followed by wheat 2 or 3 years, after which the land is again used for corn or is planted to rye, barley, oats, and sorgo. Leguminous crops are seldom used in the rotation, except on the bottom lands where considerable alfalfa is grown and on some of the sandy-land farms where sweetclover is produced. Summer fallowing is not practiced to an appreciable degree in any part of the county.

Very little fertilizer is used. Considerable barnyard manure is produced, but little care is taken to preserve it. Except on the bottom-land farms, the manure is seldom applied to the land. Most upland farmers are of the opinion that barnyard manure decays too slowly in the rather dry upland soils to be of much value to crops and that it has a tendency to dry out the surface soil, thereby doing more harm than good. During the last few years a few farmers have applied phosphate fertilizer to some of the bottom-land and sandy upland soils, and they seem to have received pronounced increases in crop yields during part of the years. However, the use of commercial fertilizer is still in an experimental stage.

Irrigation is practiced to a very limited extent. The Nebraska agricultural statistics report that only 1,400 acres are under irrigation. Most of the water for this purpose is obtained from Republican River and some from tributaries that join the river from the north. Most of the irrigated land occupies terrace positions, some is on the flood plains, and some in the lower lying uplands adjoining Republican Valley.

SOILS AND CROPS

The general-farming system in Dundy County as a whole is dominated by the livestock industry. The crops grown consist mainly of corn and hay for feed, with wheat as a cash crop. The livestock industry is dominant because of the large area of native grassland which is too rough or too sandy for grain growing. However, the farming practices and the varieties and yields of crops in any particular section are determined largely by the character and distribution of the soils.

The county lies in a region where the mean annual rainfall is rather low. The mean annual precipitation, 19.77 inches per annum at Benkelman, only slightly exceeds the minimum required for profitable grain production in the uplands, even on those soils best equipped to store moisture for the use of crops.

Only about one third of the land in the county is under cultivation. The cultivated land includes the well, but not excessively, drained areas of the silty loessial uplands in the eastern part, numerous but generally small valleys in the sand-hill region throughout the western and central parts, and rather narrow strips comprising most of the alluvial lands.

The main crop in each of these sections is corn. However, wheat is an important crop, especially on the silty uplands and terraces, and considerable alfalfa is produced on the alluvial lands and in

valleys throughout the sand-hill region where the water table is within reach of the alfalfa roots. Of the minor crops, rye and sweetclover are grown chiefly on the more stable sandy lands, barley and oats are grown principally on land which is well suited to wheat production, some sugar beets are produced on small irrigated areas in the alluvial lands, and sorgo and potatoes are grown in patches on nearly all the cultivated soils.

About two thirds of the county consists of land either so uneven that most of the rainfall is lost as run-off or so sandy and porous that much of the precipitation seeps away in the underdrainage. The soils in these areas are unable, except locally, to furnish sufficient moisture for satisfactory yields of grain and tame-hay crops, but they support good growths of native pasture and hay grasses. They occupy most of the sand-hill region and include all the hilly land and steeper valley slopes in the loess region.

The high percentage of grazing and wild-hay land is directly responsible for the importance of livestock in the general farming system of the county, because the profitable use of this land necessitates the raising of livestock. Cattle are the principal livestock raised. Nearly every ranch in the grazing areas produces from 20 to 100 feeder cattle each year, and many of these animals are fattened in the grain-producing sections before they are shipped to outside markets. Hogs, which can be economically raised in connection with cattle feeding, are also produced in large numbers throughout the grain-growing sections.

An abundance of feed is required to carry the pastured cattle through the winter and to fatten the cattle and hogs for market. The high feed value of corn and the fact that corn can be sold for cash in years when livestock fattening is unprofitable, accounts for the large acreage in this crop, compared with that in any other crop in the farming sections. Corn occupied about 63 percent of the cultivated land in 1929. However, this crop is not so well adapted to the regional precipitation as wheat, and its yields are more variable, especially in the uplands, where it is grown most extensively. Were it not that corn is so necessary in connection with livestock raising, its acreage would probably be reduced and wheat grown instead.

Wheat is the chief cash crop in nearly all years and for this reason ranks next to corn in acreage. It occupied about 12 percent of the cultivated land in 1929. The comparatively large acreages in barley and rye in recent years, as compared with the land used for oats, are partly because barley and rye each produce more pounds of feed an acre and are better hog and cattle feeds than oats and partly because the work horses have been replaced by tractors to a large extent on many farms, and less oats are needed for horse feed. Of the tame-hay acreage, about 73 percent is used for alfalfa and most of the remainder for sweetclover, both of which are important cattle and hog feeds.

The more extensive cultivated soils have developed from loess, a light-gray, limy, and silty material which is remarkably uniform in its physical and chemical properties. The soils which have weathered from this material have high moisture-retaining powers. Most of the less extensive cultivated soils have developed from sand or from mixtures of sand and loess and as a rule are rather droughty. However, all of them are better equipped to accumulate moisture for subsequent

crops than any except the most poorly drained of the soils used for native pasture and hay land. The greater part of the cultivated soils are more stable, have more even surfaces, and are less affected by wind and water erosion than are those of the uncultivated pasture and hay lands. Most of them have developed under a heavier grass vegetation, are better supplied with organic matter, and have thicker and darker surface layers than the uncultivated soils. The intensity of darkness in the topsoils is not so pronounced as in the corresponding layers of many soils in the central and eastern parts of the State and throughout Iowa, where, owing to a higher precipitation, the virgin grass growth was more luxuriant, its decay more rapid, and organic matter has accumulated in larger amounts than in western Nebraska. However, the topsoils average much darker than the subsoils, being in most places dark grayish brown or chestnut brown.

In addition to the rather dark color of their surface layers, the cultivated soils contain an abundance of lime carbonate, are friable throughout, and are easily penetrated by air, moisture, and crop roots. However, these features are not equally developed in all the cultivated soils, and some of them are absent in many of the soils which are used for native pasture and hay land. In fact, differences in the character of the parent soil materials, in the length of time these materials have been exposed to weathering, and in drainage conditions under which they have weathered, have resulted in the development of several different kinds of soil in Dundy County.

In the loess region the more nearly level upland soils have been subjected to less erosion and have thicker and darker topsoils than soils on the rolling or hilly lands. They are also more deeply leached of their lime carbonate than are the latter soils because the even surfaces on which they lie have allowed more of the rainfall to enter the ground. In local depressions throughout the loess region where water accumulates after rains, the soils have been entirely leached of their lime carbonate and, in some places, of much of their organic matter. In addition, they have developed dense claypanlike subsoils not occurring in any of the better drained soils of the county.

In the sand-hill section most of the soils have been leached of their lime carbonate. However, this section includes much soil in which lime carbonate is abundant within depths ranging from a few inches to 4 feet. All the sandy upland soils are less stable and less retentive of moisture than the loess-derived soils. They differ among themselves in texture, coherence, lime content, and moisture-retaining power. Several sandy upland soils are recognized in Dundy County.

The bottom-land soils differ from one another chiefly in the proportion of fine and coarse material which they contain and in their content of lime and organic matter. Some of them are composed almost entirely of loose gray sand, whereas others are fine textured and rather dark.

The soils of the county, although varied and rather numerous, may be separated, according to the crops which are most extensively grown on them and for which they seem to be best suited, into four broad groups as follows: General-farming soils; corn, rye, and sweet-clover soils; corn and alfalfa soils; and native pasture and hay soils. This system of grouping is not intended to indicate that the soils of a particular group are the only ones which can be used for

the crops mentioned in connection with that group. Aside from the native pasture and hay soils, which cannot be used for cultivated crops except under the most favorable conditions, all the soils can be used with greater or less success for all the crops commonly grown in the county. However, larger returns are obtained year in and year out from the soils of a particular group when those soils are used for the crops to which they are best suited. The grouping is based not only on soil and crop adaptations but also on those soil characteristics which are responsible for these adaptations and on the surface features and drainage conditions of the soils. None of the soil groups is confined to any particular part of the county, although some of the soils in each group are very local in their occurrence.

In the following pages the various soils of the county are described and their crop adaptations are discussed. The soil map accompanying this report shows the distributon of the soils in the county, and table 6 gives their acreage and proportionate extent.

TABLE 6.—*Acreage and proportionate extent of the soils mapped in Dundy County, Nebr.*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Keith silt loam	70,080	11.9	Sarpy fine sandy loam	7,488	1.3
Keith silt loam, slope phase	8,768	1.5	Sarpy silt loam	3,712	.6
Keith silt loam, deep phase	5,632	1.0	Colby silt loam, broken phase	32,640	5.5
Keith very fine sandy loam	15,488	2.6	Colby silt loam	15,040	2.5
Keith fine sandy loam	9,472	1.6	Colby very fine sandy loam	10,624	1.8
Rosebud sandy loam	1,280	.2	Canyon sandy loam	3,456	.6
Dawes very fine sandy loam	1,920	.3	Rosebud sandy loam, poorly drained phase	2,240	.4
Dawes sandy loam	5,760	1.0	Scott silt loam	1,216	.2
Bridgeport very fine sandy loam	11,520	2.0	Valentine fine sandy loam	2,176	.4
Bridgeport silt loam	9,152	1.6	Valentine loamy sand	45,248	7.7
Bridgeport fine sandy loam	6,080	1.0	Valentine sand	146,560	24.9
Tripp very fine sandy loam	384	.1	Gannett loamy sand	4,096	.7
Anselmo fine sandy loam	27,328	4.6	Dune sand	108,928	18.5
Anselmo loamy sand	18,368	3.1			
Bridgeport loamy fine sand	4,352	.7	Total	588,800	
Laurel very fine sandy loam	4,672	.8			
Sarpy loamy sand	5,120	.9			

GENERAL-FARMING SOILS

The soils of this group comprise about 80 percent of the cultivated land. They include all the Keith, Dawes, and Tripp soils, the better drained Rosebud soils, and the finer textured Bridgeport soils. Some of these soils include several soil types or phases of types, making a total of 12 individual soils, one or another of which occurs in nearly all of the less eroded parts of the county except the bottom lands. Their surfaces range from nearly level to gently rolling, and all the soils have adequate surface drainage and underdrainage. They are fairly well supplied with organic matter and have thicker and darker topsoils than any other soils in the county, except those in local spots throughout the bottom lands and in small and poorly drained depressions on the uplands.

The Keith, Dawes, and Rosebud soils are in the uplands. The first named have developed from loess and occur chiefly on nearly level or gently rolling areas of the loess section in the eastern part of the county. The Dawes soils have weathered from either silty

or moderately sandy materials, and the Rosebud soils are derived from limy sandstone. Soils of both series occupy rather small areas, chiefly in the sand-hill section. The Tripp and Bridgeport soils are in the larger stream valleys, the Tripp being confined to nearly level terraces and the Bridgeport to long colluvial slopes and gently sloping terraces.

All the soils of this group are stable under cultivation, are retentive of moisture, and are well supplied with lime. However, these characteristics vary somewhat in the different soils, the moisture-holding power and the abundance and depth of the lime especially being variable. The soils are friable and are easily maintained in good tilth. They are well adapted to most crops commonly grown in the region, and practically all the area occupied by them is under cultivation.

The upland soils of the group, although much more extensive than the terrace soils, are not quite so productive because the precipitation received by them is not supplemented by run-off from higher levels as it is on the terraces. None of the soils gives as high yields, especially of corn and alfalfa, as the best bottom-land soils, but all are adapted to a wider variety of crops than the bottom-land soils and produce higher and more uniform yields of all crops than any upland or terrace soil not belonging to the group. Corn is grown on about 55 percent of the total area occupied by these soils; wheat on about 30 percent; sweetclover, rye, and oats on about 2 percent each, and barley and alfalfa on about 3 percent each.

Alfalfa does not seem to be well adapted to the soils of this group as a whole. It gives high yields on all of them for a few seasons but seems to require more moisture than is supplied by the normal precipitation of the region, and, except in areas where the precipitation is supplemented by run-off from higher levels, yields rapidly decline after 4 or 5 years. Most of the alfalfa produced on these soils is grown in the lower lying situations throughout the uplands and on the terraces.

Keith silt loam.—Keith silt loam is the most extensive general-farming soil in Dundy County, occupying the greater part of the more nearly level or gently rolling silty uplands. The largest developments are on the tablelands in the northeastern and southeastern parts of the county.

The 12- to 15-inch topsoil is dark grayish-brown or chestnut-brown mellow silt loam well supplied with organic matter. The organic material constitutes about 2.7 percent by weight of the topmost 12 inches of soil. It is an important factor in producing and maintaining the soft mellow character of the topsoil and has strong absorbing powers for both moisture and heat. It is also the chief source of nitrogen, an important plant food. The subsoil, which extends to a depth ranging from 4 to 5 feet, is friable silt loam, grayish brown in the upper part, where it has been stained by solutions of organic matter from the topsoil, and light grayish brown or almost white in the lower part. Lime is abundant below a depth ranging from 16 to 20 inches, occurring chiefly in finely divided form thoroughly mixed with the silt. Beneath the subsoil is light yellowish-brown floury and limy silt, which extends with little change to a depth of many feet. It is the material from which the soil has

developed and is known geologically as "Peorian loess." It is exposed in nearly all the stream and deeper road cuts throughout the eastern and southern parts of the county.

Keith silt loam is highly retentive of moisture and is sufficiently porous to allow good aeration, easy root penetration, and free upward and downward movement of water.

This soil is remarkably uniform throughout the areas of its occurrence. In the more rolling sections, however, especially near areas of Colby soils, where the surface relief has allowed rather rapid run-off, erosion has somewhat thinned the topsoil, and the top of the lime carbonate layer lies a little nearer the surface of the ground than in the more level areas.

Practically all the land is under cultivation. About one half the cultivated land is used for corn, which yields an average of about 20 bushels an acre, but yields range from a little more than 60 bushels in seasons of unusually high rainfall to almost total crop failure in very dry years. Winter wheat is grown extensively, and yields are less variable than those of corn. The crop matures on moisture from spring and early summer rains and is not subject to the frequent midsummer and late-summer droughts that so greatly reduce corn yields. The average yield of wheat over a period of years is about 15 bushels an acre.

Sorgo, barley, and rye are grown on most farms occupied by this soil, usually in small fields. Sorgo yields about 2.5 tons of forage an acre, and the average acre yields of barley and rye are about 20 and 18 bushels, respectively. Alfalfa is grown on a few farms and produces about 2 tons of hay an acre during the first 4- or 5-year cropping period, after which yields rapidly decline, owing to insufficient moisture.

Keith silt loam is easily handled and will give high yields of all crops common to the region, provided the precipitation is not deficient. It can be cultivated under a fairly wide range of moisture conditions. Clods are formed if the soil is plowed when wet, but the lumps are easily reduced by subsequent tillage.

Keith silt loam, slope phase.—The slope phase of Keith silt loam resembles the typical soil in all except its topsoil features. It has developed from light-gray limy silt similar to that underlying the other Keith soils of the county, but it occupies slopes between those soils and lower-lying areas. The largest development occurs as a narrow elongated strip bordering the western edge of the nearly level loess table in Muddy, Ough, and Lutz Townships, and small areas are on one or another of the valley slopes along Indian Creek and Republican River.

Owing to its sloping position, this soil has been subjected to a little more erosion than Keith silt loam. Its topsoil is more variable in thickness, averaging considerably thinner than that of the other Keith soils. However, the slopes are much more gradual than those occupied by the severely eroded Colby soils, and areas having less than 8 inches of dark topsoil are few and small. The texture of the topsoil is silt loam in most places. However, mapped areas of this soil include small areas in which the topsoil may be fine sandy loam or very fine sandy loam.

The slope phase of Keith silt loam is adapted to all crops commonly grown in the county, but it is not quite so well supplied with

organic matter and, therefore, nitrogen as typical Keith silt loam. In addition, the slope of the land favors considerable run-off, and less of the precipitation sinks into the ground than in typical Keith silt loam. Practically all the area occupied by this soil is topographically suited to cultivation, and although the land returns slightly lower yields of corn and small grains than does Keith silt loam, it is very productive.

Keith silt loam, deep phase.—The deep phase of Keith silt loam, as mapped, includes all areas of Keith soil in which the topsoil layer is unusually thick. This layer ranges from silt loam to fine sandy loam, but it is so variable in texture within short distances that it is all classed as silt loam.

This deep soil has developed on loess, but it usually occupies slightly lower lying positions than the other loess-derived soils. Much of it occurs near the base of long gradual slopes or in slightly depressed, though well-drained, areas on the tablelands. All the bodies are small, and the total area of the soil is only 8.8 square miles. The low position with respect to the surrounding land has favored the accumulation of considerable dark-colored soil material which has washed from higher levels. The topsoil is much thicker than that of any other Keith soil, averaging about 20 inches thick. The underlying layers are limy and similar in all their features to the corresponding layers in typical Keith silt loam.

This soil is well adapted to all crops common to the county. It is a little more productive, especially of corn, than any of the other upland soils, but owing to its small extent is of minor agricultural importance. Practically all of it is under cultivation.

Keith very fine sandy loam.—Keith very fine sandy loam differs from Keith silt loam only in that it contains a little more very fine sand in the topsoil. It occurs in bodies of various sizes and shapes, the largest of which are northwest of Benkelman on isolated outliers of loess surrounded by sandy land. A few small bodies are in the loessial uplands south of Republican River.

Owing to the slightly higher sand content of its surface layers, this soil can be cultivated under a little wider range of moisture conditions than Keith silt loam. However, the sand is nowhere sufficiently abundant to make the soil unstable or to reduce its water-holding powers, and Keith very fine sandy loam is as productive of all crops as Keith silt loam. Nearly all the land is under cultivation.

This soil does not occupy a large total area and is of rather local agricultural importance.

Keith fine sandy loam.—Keith fine sandy loam occurs in close association with Keith very fine sandy loam, but it has received more wind-blown sand and has a coarser-textured topsoil than any other Keith soil in the county. One of the largest developments, comprising more than 2 square miles, is in the northwestern part of Union Township. The remaining bodies, although rather numerous, are much smaller. Most of them occur adjacent to more sandy soils in Indian Creek, Union, and Benkelman Townships.

The topsoil in most places consists of dark grayish-brown friable fine sandy loam 12 or 14 inches thick, but in a few local spots it is much lighter in color and more sandy. The subsoil is similar to that underlying the other Keith soils of the county, except that it averages a trifle coarser in texture.

Keith fine sandy loam is not quite so retentive of moisture as the finer-textured Keith soils and because of its higher sand content does not produce such high yields, especially of small grains, as those soils. However, crop yields average only slightly lower than those obtained on Keith silt loam and Keith very fine sandy loam. The soil can be tilled under almost any moisture conditions without injury. The surface relief is nearly level or gently undulating, the soil is not subject to destructive wind erosion, and practically all the land is under cultivation.

Rosebud sandy loam.—Rosebud sandy loam has developed from light-gray limy sandstone which outcrops in a few places throughout the sand-hill section of the county. Most of the soil is in the northern part of Haigler Township. The largest body comprises only about 160 acres, and the total area is only 2 square miles.

The topsoil, to an average depth of 12 inches, is a dark grayish-brown friable mixture of all grades of sand, together with small quantities of silt and considerable organic matter. The fine and medium sands predominate. The subsoil, which is about 3 feet thick, is light-gray fine sandy loam or very fine sandy loam. It is very limy below a depth of about 2 feet. This layer usually contains a higher percentage of silt and clay than the topsoil, but it is friable throughout. Disintegrated limy sandstone, from which the soil has weathered, lies about 4 feet beneath the surface of the ground.

The surface relief is nearly level or gently undulating. Drainage channels are not established, but the rather low rainfall is absorbed by the surface soil and subsoil, and no moisture accumulates on the surface of the ground.

This soil is more porous than any Keith soil in the county, but it retains water fairly well and is not regarded as droughty. It is well adapted to corn, and yields of this crop are almost as high as those obtained on Keith silt loam. Small grains do fairly well except during dry windy seasons, when the rather sandy topsoil drifts sufficiently in places to injure the shallow roots of small-grain crops. Yields, particularly of wheat, barley, and oats, average a little lower than on the finer textured loessial soils.

Dawes very fine sandy loam.—Dawes very fine sandy loam occurs mainly in a few small bodies in Lutz Township in the northern part of the county. The largest, which comprises about 450 acres, is in the vicinity of Hiawatha. The soil occupies a total area of only 3 square miles. It occurs in enclosed hard-land valleys, most of which are surrounded by sandy soils. The valleys have no surface-drainage outlets, and the soil in them receives water not only through precipitation but also through seepage and run-off from higher levels. However, moisture seldom accumulates on the surface of the ground, and the soil as a whole has adequate drainage.

The topsoil consists of mellow very fine sandy loam from 14 to 18 inches thick. It is unusually well supplied with organic matter and averages a trifle darker than the corresponding layer of any Keith soil. The upper part of the subsoil is brown or grayish brown. It contains much more silt and clay than the topsoil and, although fairly compact, is not extremely dense or claypanlike. It varies a few inches in thickness from place to place but gives way rather abruptly, in most places at a depth of about 30 inches, to very light gray loose limy silt or very fine sandy loam.

Owing to its favorable moisture supply and high organic-matter content, this is one of the most productive upland soils in Dundy County. It is well adapted to all crops commonly grown, and all the land is under cultivation. During wet springs excessive moisture sometimes reduces the wheat yields, but in seasons of normal precipitation all crops produce as well as on any Keith soil. In extremely dry years Dawes very fine sandy loam usually produces a little better than the other upland soils.

Dawes sandy loam.—Dawes sandy loam differs from Dawes very fine sandy loam only in that its topsoil contains a little more and slightly coarser sand than occurs in the corresponding layer of the very fine sandy loam. The two soils occupy similar topographic positions, but the sandy loam is more widely distributed and a little more extensive than the very fine sandy loam. The sandy loam occurs in numerous though small bodies scattered throughout the northern part of the county.

This soil is equal to Dawes very fine sandy loam for corn production, and it is also a good small-grain soil during most years. In wet seasons wheat seems to yield better on this soil than on Dawes very fine sandy loam, probably because the coarser textured topsoil allows the excessive moisture of early spring to drain out more rapidly and because the soil warms up sooner than the finer textured soil. In normal and dry years, however, Dawes sandy loam is a little more droughty than Dawes very fine sandy loam and not quite so stable. Wheat may make a good growth in early spring, but it may be more or less injured by dry weather and root exposure before it matures. Although all the land is under cultivation, probably not more than 25 percent of it is used for small-grain crops.

Bridgeport very fine sandy loam.—Bridgeport very fine sandy loam occurs on terraces and long terracelike colluvial slopes between the uplands and alluvial lands. It is rather extensively developed on the Republican River and Arikaree River benches and valley slopes and occurs locally on the larger creek terraces. It lies from 10 to 60 feet above the present stream channels and has good surface drainage and underdrainage.

This soil consists of grayish-brown friable very fine sandy loam which continues with little change in color or texture to a depth ranging from 4 to more than 5 feet. However, the immediate surface layer, to a depth of 5 or 6 inches, is slightly darker than the rest of the soil, owing to a higher organic-matter content. Lime carbonate is everywhere abundant below a depth of 12 or 14 inches and frequently occurs within 3 or 4 inches of the surface of the ground. It is in finely divided form, thoroughly mixed with the mineral soil particles.

Bridgeport very fine sandy loam is not so well supplied with organic matter as the Keith soils, as is indicated by the lighter color of its topsoil. However, it occupies lower positions than those soils and receives considerable moisture in the form of run-off and seepage from higher levels. This moisture tends to offset the rather low organic-matter content and gives the soil, as a whole, a greater producing power than Keith silt loam.

Practically all the land is under cultivation, chiefly to corn, but it is well adapted to all crops commonly grown. The average yield

of corn over a period of years is about 25 bushels an acre, that of wheat about 18 bushels, and that of rye and barley about 20 and 22 bushels, respectively. Sorgo yields about 3 tons of forage an acre, and the average acre yield of alfalfa is slightly more than 2 tons.

Bridgeport silt loam.—Bridgeport silt loam occurs on terraces and terracelike colluvial slopes similar to those occupied by Bridgeport very fine sandy loam, but it is a little less extensive than that soil. Most of it is on terraces along Republican and Arikaree Rivers.

The soil resembles Bridgeport very fine sandy loam in its surface and drainage features and differs from that soil only in that it contains a higher percentage of silt throughout. It consists of friable grayish-brown silt loam to a depth exceeding 3 feet.

All the land is under cultivation and is used for the same crops as are grown on Bridgeport very fine sandy loam. It is a little more retentive of moisture than that soil, owing to its higher silt content. However, neither the silt loam nor the very fine sandy loam receives as much moisture as it can retain, and both soils are about equally productive.

Bridgeport fine sandy loam.—Bridgeport fine sandy loam occupies topographic positions similar to those on which the other Bridgeport soils are developed, and it is closely associated with those soils. However, it usually occurs in smaller bodies than either the very fine sandy loam or silt loam types, and it is not very extensive. The greater part of it lies in the Republican River and Arikaree River Valleys, and small bodies are on the valley slopes along Spring, Horse, and Indian Creeks.

This soil, although similar in its major characteristics to the other Bridgeport soils, has a noticeably higher sand content and slightly lower organic-matter content than either Bridgeport silt loam or Bridgeport very fine sandy loam, and it is not quite so retentive of moisture as those soils. It consists of grayish-brown loose fine sandy loam which remains uniform in texture to a depth of more than 3 feet. The color of the soil is also remarkably uniform throughout, except that the topmost few inches are slightly darker than the rest.

Practically all the land is under cultivation and is used for the same crops as are commonly grown on Bridgeport very fine sandy loam and Bridgeport silt loam. Yields, particularly of small grains, average about 15 percent lower than on those soils. Corn does almost as well as on Bridgeport silt loam in seasons of normal or high precipitation, but in dry years this crop suffers more from drought and yields a little lower than on the finer textured Bridgeport soils. Alfalfa is seldom grown on this soil, owing to the difficulty of obtaining a sufficiently firm seed bed.

Tripp very fine sandy loam.—Tripp very fine sandy loam occupies only 384 acres. It occurs in six small bodies on rather high terraces in the Republican River Valley. The largest, comprising about 120 acres, is south of Parks in the southern part of the county. The surface relief is nearly level, but it slopes very gently toward the stream channel. The areas lie from 20 to 30 feet above the normal flow of the river, and all the land is well drained.

Tripp very fine sandy loam is identical with Keith very fine sandy loam in all soil features and differs from that soil only in topographic

position. It resembles Bridgeport very fine sandy loam to some extent but has a darker and thicker topsoil, and lime lies at a slightly greater depth. The same crops are grown as on the Keith soils, but yields average about 20 percent higher than on those soils, owing largely to more favorable moisture conditions. The soil receives moisture not only through precipitation but also through seepage and run-off from the uplands. It is a trifle more productive than any Bridgeport soil, largely on account of the higher organic-matter content of its topsoil.

All the land is under cultivation, but, owing to its small extent, it is of negligible agricultural importance in Dundy County. It is shown separately on the soil map chiefly because it is the oldest alluvial soil in the county and the only one of these which may be regarded as fully developed or mature. It is, therefore, of considerable value in tracing the development of the valley soils.

CORN, RYE, AND SWEETCLOVER SOILS

The soils of this group occupy only 8.4 percent of the total land area of Dundy County. They include the Anselmo soils and a coarse-textured Bridgeport soil, all of which are composed largely of sand. The Anselmo soils occupy numerous though usually small areas in the uplands throughout the sand-hill section, and the Bridgeport soil occupies long colluvial slopes or gently sloping terraces chiefly in the Republican River Valley.

These soils have not accumulated so much organic matter as the soils of the general-farming group and, owing to their higher sand content, are less stable than those soils. However, they contain sufficient well-decomposed vegetal material to give their topsoils a darker color than usually occurs in the corresponding layers of the native pasture and hay soils. In addition, they contain considerable silt mixed with the sand, especially in the upper part of the soil profile, and they are fairly stable, provided care is exercised in handling them.

The surface relief of these soils ranges from nearly level to rolling. Drainage channels are not well established, because most of the precipitation is absorbed by the sand. The topsoils, which are from 8 to 12 inches thick, are grayish brown or light chestnut brown, and they range in texture from fine sandy loam to loamy sand. The subsoils are composed largely of loose gray sand. The silt and organic matter in the topsoil layers enables these layers to retain considerable moisture, but the high sand content of the entire soil makes the soils rather droughty. During dry windy weather they are subject to some drifting unless protected by vegetation.

In seasons of high precipitation the soils of this group are almost as productive of all crops commonly grown as any of the upland and terrace soils, but in seasons of normal or subnormal rainfall crop yields are lower than on the finer textured cultivated soils. When such seasons are accompanied by considerable windy weather, as they usually are, most small-grain crops, particularly wheat, barley, and oats, yield especially low because the drifting sand exposes their shallow root systems to drought. Wheat also yields very low on these soils following dry cold winters. The root system of this crop seems unable to survive freezing in dry sand as well as in

moister and finer textured soils, and wheat is often badly winter-killed. It is grown on less than 2 percent of the area occupied by the soils of this group, and oats, barley, and alfalfa occupy only a few small fields. Alfalfa does not seem to obtain sufficient moisture on these soils, and the loose sandy topsoil does not afford the firm seed bed so necessary for obtaining good stands of this crop. The plants are usually rather sparse even in fields which have been recently planted.

Corn, rye, and sweetclover seem to be better adapted to the soils of this group than any of the other crops grown in the county, and about 85 percent of the area occupied by these soils is used for one or another of these crops. The remaining percentage not used for alfalfa, for small grains other than rye, or for potatoes, sorgo, and garden vegetables, is included in farm pastures or native-hay land.

Corn, which is planted rather deeply, is not greatly injured by drifting sand. This crop has a much deeper and wider spreading root system and can obtain moisture from greater depths and larger areas than can small grains. It produces fair yields even in the drier years, and since it is the most important feed crop it is naturally grown most extensively. During most years it occupies about 80 percent of the cultivated land in this soil group.

Rye, although not an important crop in any part of Dundy County, is grown on a larger proportion of the area occupied by the corn, rye, and sweetclover soils than any other small-grain crop. This is largely because rye is better adapted to sandy soils than the other small grains common to the region. It is a winter crop as is wheat, but it has more the characteristics of a perennial grass and generally produces a more luxuriant fall growth, which better protects the land from blowing, than wheat. It is also more hardy, will thrive on less moisture, and is less subject to winter-killing in dry sandy land than wheat. During most years rye is grown on about 5 percent of the cultivated land in this soil group.

Continued grain production rapidly depletes the nitrogen in the sandy soils, and in order to remedy this situation considerable sweetclover is grown. This crop, although not valued so highly for feed as alfalfa, is much better adapted to the sandy soils than that crop. Less difficulty is experienced in obtaining a good stand of sweetclover than of alfalfa. The crop thrives on less moisture, can be sown earlier in the spring, and is much hardier than alfalfa. In addition, sweetclover is as well equipped as alfalfa to obtain nitrogen from the air and store it in the soil and to retard soil blowing. Without sweetclover the farmers on the sandy soils would have practically no means of advantageously rotating their crops or of maintaining profitable yields of corn. Sweetclover is annually grown on about 10 percent of the cultivated land of the corn, rye, and sweetclover soil group.

Anselmo fine sandy loam.—Anselmo fine sandy loam is the most extensive soil of the corn, rye, and sweetclover group. It occupies bodies of various sizes and shapes throughout the sand-hill section, mainly in the eastern and southern parts of the section. One of the largest, comprising but 1,200 acres, is in the northeastern part of Parks Township, an area is south of Twin Lakes in Benkelman Township, and there are many smaller bodies.

Practically all the land is topographically suited to cultivation. The surface relief ranges from nearly level to strongly rolling but does not have the hummocky or hilly appearance so characteristic of dune sand and the Valentine soil areas. Drainage channels are not developed, but the soil is sufficiently porous to absorb rapidly the surplus surface moisture, and all the land is well drained.

Anselmo fine sandy loam is remarkably uniform to a depth ranging from 3 to more than 4 feet. It consists largely of fine sand or medium sand but contains enough silt to give the sandy material considerable body. It is more stable than any other soil in the group. However, it is subject to some wind erosion if not protected by vegetation. The surface layer, to a depth of 7 or 8 inches, contains enough organic matter to give it a dark grayish-brown color, but the rest of the soil is light gray, owing to a scarcity of this material. The soil is very limy below an average depth of 20 inches.

Anselmo fine sandy loam is less productive than any soil classed in the general-farming group. It is more droughty than those soils and does not contain so much organic matter or nitrogen. However, it gives larger returns when used for grain and tame-hay crops, particularly corn, rye, and sweetclover, than when it is allowed to remain in native pasture or hay land. About 90 percent of it is under cultivation. Corn is grown chiefly, this crop occupying about 85 percent, rye about 5 percent, and sweetclover most of the remainder of the cultivated land.

Crop yields vary widely from year to year, depending on the amount and distribution of rainfall. The average yield of corn is about 18 bushels an acre, of rye about 15 bushels, and of sweetclover about 2½ tons of hay. Alfalfa and small grains, other than rye, are grown in small patches, but yields are rather low except in the most favorable seasons.

The uncultivated parts of this soil are included in native pasture and hay land.

Anselmo loamy sand.—This soil differs from Anselmo fine sandy loam chiefly in that it has a lower silt content and is a little less stable. It occurs in the sand-hill section and is similar in surface features to Anselmo fine sandy loam, but it occupies fewer and more widely scattered bodies than that soil and is less extensive.

The soil is composed largely of grayish-brown sand, the 6- or 7-inch surface soil of which contains sufficient organic matter to make it slightly darker than the rest of the soil. There is sufficient silt in the upper part of the soil profile to give the soil more body and greater stability than occurs in any of the Valentine soils, but not enough to prevent soil drifting in cultivated fields, especially during prolonged periods of dry windy weather. The silt decreases downward, and below a depth of 2 or 3 feet the soil is composed almost entirely of incoherent grayish-brown sand similar to that underlying the Valentine soils, except that it is much more limy.

About 70 percent of Anselmo loamy sand is under cultivation. This soil is more droughty and less productive than Anselmo fine sandy loam. However, it produces fair yields of corn, rye, and sweetclover in all except the driest years, and practically all the cultivated land is used for these crops. Corn is grown most extensively.

The uncultivated parts of this soil support a denser grass cover than that growing in the dune sand or Valentine soil areas. Such areas are used for grazing and native-hay land.

Bridgeport loamy fine sand.—Bridgeport loamy fine sand resembles Anselmo loamy sand, except that it is composed of a slightly finer grade of sand and occurs in lower lying and more terracelike positions. This soil is the least extensive of those classed in the corn, rye, and sweetclover group. It occurs in numerous, though usually small, bodies, most of which are on terraces or terracelike colluvial slopes in the Republican River and Arikaree River Valleys.

All the land lies well above stream overflow and is well drained. About 85 percent of it is under cultivation and is used for the same crops as are grown on the Anselmo soils. The soil is sandier, more droughty, and less stable than the other Bridgeport soils. In fact, it is not so retentive of moisture as the finer textured Anselmo soils. However, it receives considerable water from higher levels in the form of seepage and run-off, which, together with the water received through precipitation, makes it slightly more productive than the Anselmo soils.

CORN AND ALFALFA SOILS

The soils of this group occupy only 32.8 square miles in Dundy County. They occur in first bottoms or flood plains along the rivers and larger creeks and are well supplied with moisture. They include 1 Laurel and 3 Sarpy soils.

The material from which these soils have developed consists of recently deposited stream sediments, none of which has been greatly altered by weathering, and their character is the dominant factor in determining the character of the soils. Most of the sediments came from light-colored geological formations, and the greater part of the bottom-land soils are rather low in organic matter and are light in color. However, the moist conditions prevailing in the flood plains favor rapid vegetal growth and decay, and in local spots the decomposed vegetation has given the soil a very dark color. Those soils of the group which have developed from the finer textured sediments, chiefly silts, washed from the loessial uplands are classed with the Laurel soils, and those which have been formed from sandy sediments, with the Sarpy soils.

The bottom lands slope almost imperceptibly down the valleys and toward the stream channels. The surface relief is remarkably smooth. Surface drainage is rather slow but is well established, except locally. Much of the land is subject to overflow during high stages of the streams, and most of it lies from 3 to 6 feet above the normal level of the channels, and the water drains off within a few hours after the streams subside. The only poorly drained areas are in small local depressions, from which the water is forced to seek outlet through seepage. The ground-water table in the larger valleys ranges from 4 to 12 feet beneath the surface of the ground, and the lower part of the subsoil is well supplied with moisture, even in the drier years.

This group of soils, although not very extensive, includes the most productive corn and alfalfa soils in the county. About 85 percent of the area occupied by these soils is under cultivation. About 90 per-

cent of the cultivated land is used for corn, about 7 percent for alfalfa, and the rest is included in small fields or patches of sugar beets, potatoes, oats, forage crops, and garden vegetables. A few farmers have constructed short irrigation ditches in the Republican River Valley, and a large proportion of the sugar beets and potatoes, both of which are very minor crops, is produced under irrigation. The uncultivated land occurs either in strips too narrow for profitable farming, in bodies too poorly drained for cultivation, or is covered by native forest, and is usually included in farm pastures.

The high acreage in corn and alfalfa, compared to that in other crops on these soils, is owing almost entirely to the abundant moisture supply. Alfalfa, which can seldom be profitably grown for more than a few years on the best upland soils of the general-farming group on account of moisture deficiency, gives high yields year after year on the bottom-land soils. Small-grain crops also thrive on the bottom lands, but in most places they have a tendency to produce a rank vegetal growth with long, weak stems, many of which break and lodge during windy weather. In addition, small grains usually mature late and produce rather low yields. Oats yield fairly well, provided short stiff-stemmed varieties are grown, but even these varieties have a tendency to grow rank at the expense of the grain, and are of minor importance on any of the bottom-land soils.

Laurel very fine sandy loam.—The outstanding characteristic of this soil is the fine texture of its subsoil layer, in contrast to the coarser sandy character of the corresponding layer in the Sarpy soils. It occupies numerous small bodies in the bottom lands, chiefly along Republican and Arikaree Rivers. Its total area in Dundy County is 4,672 acres.

The 7- to 10-inch topsoil is grayish brown or light grayish brown. It ranges in texture from very fine sandy loam to silt loam, very fine sandy loam predominating. This layer is underlain by light-gray or almost white silt which extends to a depth exceeding 3 feet. In most places the light-colored silt is loose and floury throughout, but locally it is slightly heavier in the upper than in the lower part of the subsoil. An abundance of finely divided lime is thoroughly mixed with the mineral soil particles in both the topsoil and subsoil.

This soil lies only a few feet above the normal level of the river channel and is subject to occasional overflow, especially during early spring. However, the water drains off rapidly, except in local depressions, and more than 90 percent of the land is under cultivation. The underlying water table is everywhere within a depth of 10 feet, and the subsoil is kept moist even in the drier years.

As on all the bottom-land soils, corn and alfalfa are the leading crops. They are grown in the proportion of 9 or 10 acres of corn to 1 acre of alfalfa. These crops during average years yield from 10 to 20 percent higher on Laurel very fine sandy loam than on any other soil in the county. However, this soil is of very minor agricultural importance because of its small extent.

Sarpy loamy sand.—Sarpy loamy sand occupies 5,120 acres in Dundy County. It occurs in numerous small bodies and narrow strips in the bottom lands, chiefly along Republican and Arikaree Rivers. One of the largest developments, comprising about 160 acres, is along Republican River near the eastern boundary of the

county. Another body of similar size is east of Haigler. This soil lies approximately 4 feet above the normal level of the river channel and is subject to overflow during flood stages of the stream. However, the surplus surface water drains off or seeps away within a short time after the stream subsides, and most of the land is well drained.

The soil consists of incoherent grayish-brown sand of fine and medium grades to a depth exceeding 3 feet. The topmost 4 or 5 inches contain sufficient organic matter to give the material a more loamy texture and slightly darker color than the rest of the soil but not enough to entirely prevent the sand from drifting, especially in cultivated fields. The subsoil and in many places the surface soil are limy.

The surface relief in most places is nearly level, but in some areas the sand has been whipped by the wind into low mounds and ridges, with intervening shallow depressions. However, the range in relief seldom exceeds 2 feet. The sand on top of the ridges is usually lower in organic matter, lighter in color, and slightly coarser in texture than that in the depressions.

About 80 percent of the land is under cultivation. Corn and alfalfa, in the proportion of about 10 acres of the former to 1 acre of the latter, are the principal crops. Small fields of potatoes, sweetclover, and sugar beets are also grown. The sugar beets are produced under irrigation.

This soil is not quite so productive as the finer textured Sarpy and Laurel soils of the bottom lands, but it gives higher yields, especially of corn, than any upland or terrace soil in the county. It is also more productive of alfalfa than those soils, provided comparison is made on equally dense stands of this crop. Part of the alfalfa seed planted on this soil fails to germinate in the loose, rather unstable sand, and it is usually necessary to use a few more pounds of seed to the acre on Sarpy loamy sand than on the finer textured soils. However, alfalfa does exceptionally well after it has passed the seedling stage and seldom suffers from lack of moisture. The average yield of corn is about 28 bushels an acre and that of alfalfa about 2½ tons. Potatoes produce from 90 to 150 bushels under dry-farming methods, and the average yield of irrigated sugar beets is about 12 tons an acre.

The uncultivated parts of the soil, including a few poorly drained spots and areas which are covered with native trees, are used for pasture land. They produce a good growth of moisture-loving grasses and will usually support a cow or horse on each acre during the summer grazing season.

Sarpy fine sandy loam.—Sarpy fine sandy loam is similar to Sarpy loamy sand except that it contains a higher percentage of silt, fine sand, and very fine sand to a depth of about 8 inches than occurs at a corresponding depth in the loamy sand. It is a more stable soil than Sarpy loamy sand and is not subject to much wind erosion, even during prolonged dry and windy spells.

This soil occupies numerous small bodies in the Republican and Arikaree Rivers flood plains. It is more extensive than Sarpy loamy sand. It is one of the most productive corn and alfalfa soils in the county, practically all the area occupied by it being used for these crops. The average yield of corn over a period of years is about 30 bushels an acre, and that of alfalfa is about 3 tons of hay. Some

potatoes, sweetclover, and barley are also produced, but the total area devoted to these crops is small.

Sarpy silt loam.—Sarpy silt loam resembles the other Sarpy soils, except that its topsoil, which extends to a depth of 6 or 7 inches, is finer in texture than the corresponding layers of those soils. The topsoil is grayish-brown friable silt loam which is rather low in organic matter but in most places contains a little more of this material and has a slightly darker color than the surface layers of the more sandy Sarpy soils. The rest of the soil profile, to a depth exceeding 3 feet, is composed of loose gray sand.

Sarpy silt loam occupies some of the lowest positions in the Republican and Arikaree Rivers bottom lands and does not drain quite so rapidly after overflows as do the coarser textured and higher lying Sarpy soils. However, the poorly drained areas are very small and scattered. About 90 percent of the land is used for corn and alfalfa, for which it is admirably suited. These crops are grown in about the same acreage ratios as on the other Sarpy soils. They usually yield a trifle higher on this soil than on Sarpy fine sandy loam.

Owing to the rather fine texture of its topsoil layer, Sarpy silt loam cannot be cultivated under so wide a range of moisture conditions as the coarser textured bottom-land soils. If plowed too soon after rains or periods of overflow, hard clods are formed, which require subsequent wetting and drying before granulation is restored. However, good tilth is easily maintained under average moisture conditions.

Sarpy silt loam, although one of the best corn and alfalfa soils in the county, occupies only 3,712 acres and is of minor agricultural importance. Most of it occurs in bodies ranging in size from 10 to 60 acres.

NATIVE PASTURE AND HAY SOILS

The soils of this group occupy more than 50 percent of the total land area in Dundy County. One or another of them occurs in all parts, wherever the land is too rough or too poorly drained for cultivation or the soil is too thin, unstable, or droughty to be used for grain or tame-hay crops. They include dune sand, the Colby, Valentine, Canyon, Scott, and Gannett soils, and a poorly drained phase of Rosebud sandy loam. Several of these soils include some land under cultivation, but the greater part of each remains in its virgin state, and about 90 percent of the area occupied by the group as a whole is used for native pasture or hay land.

All these soils occur in the uplands. However, the Scott and Gannett soils and the poorly drained phase of Rosebud sandy loam occupy shallow basins below the general level of the surrounding uplands.

The soils of this group include a wide range in topographic and soil features. The Valentine soils and dune sand are composed largely of fine or medium sand, the topmost few inches of which has been only slightly darkened by organic matter. They occur principally in the sand-hill region through the western part of the county but are locally developed south of Republican River in the southeastern part. Dune sand is rather unstable, and the surface relief is strongly rolling or hilly. The Valentine soils are rolling or hummocky and, al-

though subject to considerable wind erosion, are fairly stable, provided they are not overgrazed or brought under cultivation.

The Colby soils occupy steep valley sides and narrow tortuous ridges throughout the more severely eroded parts of the loess-covered area, and they occur extensively in the eastern, south-central, and southwestern parts of the county. They have developed from light-gray limy and floury silt which is similar to that underlying the Keith soils, but which has been so severely eroded that the accumulation of organic matter has been prevented or greatly restricted. The soils are composed largely of unweathered or only slightly weathered loessial silt and are very light colored throughout.

The Scott, Gannett, and poorly drained Rosebud soils have developed under wet conditions which have especially favored vegetal growth and decay. The Scott soil occurs in small basins throughout the more nearly level parts of the loessial uplands, and the Gannett and poorly drained Rosebud soils occupy similar basins throughout the sand-covered parts of the county. These soils have accumulated sufficient quantities of well-decomposed organic matter to make the topsoils much darker than that in any other soil in the county. However, they are too poorly drained to be used for cultivated crops.

The Canyon soil is well drained, but its topsoil contains very little organic matter and is prevailingly light in color. In addition, it rests on sandstone within a depth of a few inches and cultivating machinery cannot be used on it. This soil occupies areas of various, but usually small, sizes throughout the sand-hill section of the county.

The utilization of the soils classed with the native pasture and hay group depends on cattle raising, because none of these soils can be profitably farmed except in local and small fields where the soils more nearly resemble those of another soil group than of the one in which they are classed. Such fields occur chiefly on the longer, more gradual, and less eroded slopes within areas of Colby soils and in the more protected and lower lying situations throughout the Valentine soil areas. Even in these localities the soils give much lower average yields of cultivated crops than any soil commonly used for these crops.

Colby silt loam, broken phase.—The broken phase of Colby silt loam is the most extensive fine-textured soil in the native pasture and hay soil group. It occurs throughout the uplands in the eastern part of the county, wherever erosion has carved the gray limy loess to a rugged surface relief. The largest developments are along the upper valley slopes on each side of Republican River in the southeastern part of the county. The soil also occurs rather extensively south of Republican River in the southern and southwestern parts, and it occupies strips of various widths on the steeper valley slopes along Muddy Creek, Indian Creek, and Kelley Gulch. Narrow, nearly level canyon floors are included with this soil in mapping.

This soil, although developed from loess similar to that underlying the Keith soils, has been subjected to such severe erosion that it has been unable to accumulate much organic matter. The topsoil, even in the less eroded areas, in few places exceeds 5 inches in thickness, and in most places the soil consists of gray floury silt, the topmost 2 or 3 inches of which has been only slightly darkened by organic matter. In most places the entire soil is very limy.

The broken phase of Colby silt loam is topographically unsuited to cultivation. However, it supports a denser growth of prairie grasses than dune sand or any of the Valentine soils, and it is one of the leading grazing soils in the county. The principal grasses are grama and little bluestem, although big bluestem is common on many of the narrow canyon floors and lower valley slopes. The native grasses will support a cow or horse on each 6 or 7 acres during the summer grazing season, from May to October, inclusive. Some hay is cut on the narrow canyon floors, and yields of about one half ton an acre are obtained in seasons of normal rainfall.

Included with mapped areas of this soil are several bodies in which the surface layer to a depth of 3 or 4 inches contains sufficient wind-blown sand from nearby sandy areas to give it a very fine sandy loam or even a fine sandy loam texture. These areas support the same species of grasses as the broken phase of Colby silt loam and have about the same grazing value as that soil.

Colby silt loam.—Colby silt loam differs from its broken phase in that its surface relief is less rugged and its topsoil is a trifle thicker. It occurs in close association with areas of the broken phase but is much less extensive. A few of the larger developments exceed a square mile in size, but most of the bodies are much smaller.

This soil has been subjected to considerable erosion, but the land is not so steeply sloping or so severely gullied as that of the broken phase. The topsoil in most places has accumulated sufficient organic matter to give it a grayish-brown or chestnut-brown color to a uniform depth between 5 and 7 inches. It is composed largely of loose friable silt and rests directly on unweathered light-gray floury loess. The topsoil in few places contains sufficient lime to effervesce when dilute hydrochloric acid is applied, but the rest of the soil profile is very limy.

Practically all the land is topographically suited to the use of farm machinery. However, it occupies rather steep slopes, and when the native sod is broken the soil erodes badly unless a vegetal covering is maintained. For this reason only a small part of it is used for grain or tame-hay crops. Corn and sweetclover are the leading crops grown. Yields of these crops on recently broken sod are only about 10 percent below those obtained on Keith silt loam, but unless the Colby soil is very carefully managed, erosion rapidly removes the loosened topsoil, forms gullies, and renders the land uncultivable.

The greater part of the soil is used for pasture or hay land. The grasses grow a little more luxuriantly than on the broken phase of Colby silt loam and during the summer grazing season will support a beef animal on about 5 acres. When cut for hay they yield slightly more than one half ton an acre in average years.

Colby very fine sandy loam.—Colby very fine sandy loam occupies several small bodies on the valley slopes along Republican and Arikaree Rivers and some of the larger creeks in the loess-covered parts of the county. Most of it occurs in close association with one of the other Colby soils, but it is less extensive than any of them. It differs from Colby silt loam only in the slightly higher sand content of its surface layer. The soil has developed from gray limy upland loess similar to that underlying the other Colby soils, but it has received sufficient wind-blown sand to give its surface layer a very fine sandy loam, and locally a fine sandy loam, texture.

A small part of this soil is used for corn and sweetclover, and yields are about the same as on Colby silt loam. However, considerable difficulty is experienced in preventing severe erosion when the virgin sod is destroyed, and the greater part of Colby very fine sandy loam remains with its natural covering of grasses. The soil is used chiefly for pasture or hay land. It is equal to Colby silt loam for the production of wild hay or for grazing purposes.

Canyon sandy loam.—This soil, as mapped in Dundy County, includes areas in which white limy sandstone is everywhere within 10 or 12 inches of the surface of the ground and in numerous patches is exposed, giving the land a white and brown spotted appearance. The topsoil where thickest consists of mellow fine sandy loam or very fine sandy loam, but it has accumulated very little organic matter and is brown or grayish brown in color. In most places it contains white limy sandstone fragments of the bedrock formation and in places considerable water-worn gravel is present. The sandstone is similar to that underlying the Rosebud soils. In fact, Canyon sandy loam may be regarded as a very shallow and poorly developed phase of Rosebud sandy loam.

This soil occupies a few small bodies scattered throughout the sand-hill section. One of the largest, comprising about 600 acres, is south of Buffalo Creek in Haigler Township. Slightly smaller bodies are on both sides of Rock Creek in Parks Township.

The surface relief ranges from nearly level to gently rolling. Much of it is characterized by low mounds and ridges, but the difference in elevation in any particular area in few places exceeds 3 feet. The shallowness of the topsoil is probably the result of rapid wind erosion, by which the soil material has been removed almost as fast as, and in places faster than, weathering has broken down the parent sandstone.

Canyon sandy loam is all included in pasture land. It supports a rather sparse growth of grama and little bluestem, together with some sandgrasses. In dry years the vegetation usually withers and dries, owing to lack of moisture, and the soil does not have a high value even for grazing purposes.

Rosebud sandy loam, poorly drained phase.—This soil has developed on white limy sandstone similar to that beneath the Rosebud and Canyon sandy loams. It occurs chiefly in the northwestern part of the county where it occupies several small pockets and basins usually within areas of Valentine soil. The basins have no surface drainage outlets, and the underlying sandstone prevents underdrainage. The moisture accumulating in the basins escapes slowly, through evaporation and lateral seepage, and the soil occupying them remains in a rather marshy condition the greater part of each year.

The abundant moisture supply has favored the rapid growth and decay of sedges, rushes, and coarse water-loving grasses. The topsoil, which extends to an average depth of 10 inches, is very dark, in many places almost black, owing to an abundance of decayed vegetal material. It ranges in texture from fine sandy loam to very fine sandy loam and is friable even when moist. The subsoil consists of gray sandy clay, in most places containing numerous rust-brown and white spots, splotches, and streaks. The material in this layer is more compact than the topsoil but is so saturated with water

that it has a sticky plastic feel. This material rests, at a depth ranging from 3 to 4 feet, on the light-gray limy sandstone from which the soil has developed. The subsoil and in most places the topsoil are very limy.

This soil is too poorly drained for cultivation. Some of it is included in pasture land, but the greater part is used for the production of wild hay. Hay yields ranging from 1 to 2 tons an acre are common. The hay is somewhat inferior to that cut from the better drained soils, but the high yields tend, in a measure, to offset the inferior quality.

Scott silt loam.—Scott silt loam is one of the least extensive soils in Dundy County. It occupies a few shallow basins, locally called "buffalo wallows" or "lagoons", on the more nearly level loessial uplands in the northeastern part. The largest two developments, comprising about 160 acres each, are in Calvert Township. The other bodies range in size from a few square rods to about 80 acres. Most of them are in Ough Township. The basins have no surface drainage outlets, and after heavy rains water stands in them for several weeks at a time.

The topsoil, although friable, is only 8 or 9 inches thick. The upper part is well supplied with organic matter and is very dark. The lower part may or may not be dark, but in most of the deeper and more poorly drained basins it contains sufficient leached silt to give it a grayish-brown or almost white color. The subsoil, which extends to a depth ranging from 5 to 6 feet, consists of stiff dark-gray or slate-colored clay which is impervious to water and difficult to penetrate with digging tools. Beneath this claypanlike layer is light-gray silt similar to that under the Keith and Colby soils, except that it has been leached of its lime.

Scott silt loam is not used for grain and tame-hay crops, on account of its poor drainage and claypanlike subsoil. Wild hay is cut from the larger areas, but the smaller ones are included in pastures or are regarded as waste land. The hay from this soil generally includes a considerable amount of coarse vegetal material, such as rushes, sedges, and cattails, and it is of rather low quality. During prolonged droughts the soil cracks badly, causing the natural vegetation to wither and die, and the land does not have a high value even for pasture and hay land. However, as it occupies small and scattered areas, it does not seriously reduce the producing power of the farms on which it occurs.

Valentine fine sandy loam.—Valentine fine sandy loam occurs in several scattered bodies, chiefly in the southeastern part of the county. The soil is composed largely of sand, but most of the bodies are near or adjacent to areas of silty soils and have received some wind-blown silt from these areas. The individual areas range in size from 10 to about 160 acres, and the total area of this soil is only 2,176 acres.

The surface features and drainage conditions are similar to those of Valentine loamy sand, but the surface layer is darker, finer textured, and more stable than that of any other Valentine soil. The 10-inch topsoil consists of dark grayish-brown friable fine sandy loam with a rather high organic-matter content. The subsoil is loose gray sand similar to that beneath the dune sand areas.

Valentine fine sandy loam is fairly well suited to corn, rye, and sweetclover. However, most of it occurs in close association with soils which are more productive and which are suited to a wider variety of crops, and for this reason a comparatively small proportion of the land is under cultivation. On most farms the soil is included in small pastures for the milk cows and work animals, and the cultivated areas are used chiefly for corn and rye, which yield about the same as on areas of Anselmo fine sandy loam.

Valentine loamy sand.—Valentine loamy sand differs from Valentine sand only in that its topsoil is a little better supplied with organic matter and is a trifle thicker. This soil occurs in close association with Valentine sand and dune sand but is much less extensive than either. The greater part lies in dry sand-hill valleys, and the soil has a nearly level or gently undulating surface relief in contrast to the rolling or hummocky relief in most of the Valentine sand areas. The numerous valleys are of various sizes and shapes. However, only a few of them exceed 600 acres in size. Surface drainage channels are not established, but all surplus moisture rapidly seeps away through the porous sand.

The higher organic-matter content of its surface layer makes this soil a little more stable than Valentine sand and has prompted some farmers to break the sod for cultivated crops. Fair yields of corn and rye are obtained during the first 2 or 3 years of cultivation. However, the organic content is not sufficient to prevent the sand from drifting when the grassy cover is removed, and the cultivated areas rapidly become areas of gray blow sand which have no value even for pasture land.

Practically all the soil remains with its natural grassy covering. It supports a rather heavy growth of sandgrass, needlegrass, and big bluestem, and it has a somewhat higher grazing and hay value than Valentine sand. In average years the grasses on 8 or 9 acres will support a cow or horse during the summer grazing season or when cut for hay will yield from one third to one half ton an acre, depending on the rainfall.

Valentine sand.—Valentine sand occupies nearly one fourth of the total area of Dundy County. It is closely associated with dune sand which it resembles in most of its characteristics, but it supports a little heavier grass cover and is more stable. The surface relief is rolling or hummocky in most places, but it is not characterized by high dunelike hills, such as occur in typical dune sand areas. In places the land is nearly level.

The soil consists of grayish-brown incoherent sand to a depth exceeding 6 feet. The surface layer to a depth of 4 or 5 inches has accumulated a little organic matter, and in most places it is slightly darker than the rest of the soil. However, the organic content is not sufficient to prevent drifting when the native sod is destroyed. There is no surface drainage. The precipitation rapidly percolates into and through the porous sand and has thoroughly removed all lime.

Valentine sand is of little value for the production of crops, on account of its unstable character, low organic-matter content, and low water-retaining power. Practically all of it is included in pasture and hay land. It has a slightly higher grazing and hay-producing value than dune sand and, owing to its more even surface, is used more extensively for native-hay production.

Gannett loamy sand.—This soil occupies several small poorly drained basins throughout the sandy lands in the northwestern part of the county. The basins have no surface-drainage outlets and are similar in general appearance and drainage conditions to the basins occupied by the poorly drained phase of Rosebud sandy loam.

The topsoil, which is about 8 inches thick, contains an abundance of organic matter and is very dark grayish brown or almost black. It ranges in texture from loamy sand to fine sandy loam, the loamy sand predominating. The upper part of the subsoil consists of gray or grayish-brown incoherent sand containing numerous rust-brown streaks, spots, and splotches, owing to poor drainage. Below a depth ranging from 2 to 3 feet, the loose sand gives way rather abruptly to a layer of bluish-gray sticky plastic sandy clay which ranges in thickness from 8 to 12 inches. Beneath this material is loose gray sand similar to that in the upper part of the subsoil. The soil is very limy throughout.

This soil differs from the poorly drained phase of Rosebud sandy loam in that the upper and lower layers of the subsoil are more sandy and less coherent than the corresponding layers of the Rosebud soil, and in that the limy sandstone, which underlies all the county, lies much deeper than in the poorly drained Rosebud soil. No indurated material is reached within a depth of 8 feet in areas of Gannett loamy sand. The soil somewhat resembles Sarpy loamy sand but is not so well drained and has a thicker and much darker topsoil. The subsoil also contains the bluish-gray silty clay layer which is not present in any Sarpy soil.

Gannett loamy sand cannot be used for cultivated crops, on account of poor drainage. Practically all the land is used for the production of wild hay, for which purpose it is as well suited as the poorly drained phase of Rosebud sandy loam.

Dune sand.—Dune sand, although not a soil, is of value chiefly for pasture land, and for this reason it is included with the native pasture and hay soils. It occupies very extensive areas in the western two thirds of the county and is locally developed on valley slopes in the southeastern part.

This material consists of incoherent gray sand which has been whipped by the wind into a succession of irregularly distributed hills and ridges, the tops of which are from 20 to 50 feet above the intervening valleys and pockets. Surface drainage channels are not established, as all moisture is rapidly absorbed by the loose porous sand. The material in most places supports a fair growth of sandgrass, needlegrass, and big bluestem, but bare spots, or blow-outs, occupy a square rod or two on many of the hills, especially on the northwest side.

Practically all the dune sand is used for pasture land. A few of the lower lying and more stable areas are included in hay meadows. The native grasses will support from 45 to 50 head of cattle on each square mile. The hay on the more stable areas yields from one fourth to one third ton an acre, depending on the rainfall.

Dune sand should not be overgrazed, as its stability depends on its covering of grasses. When the land is brought under cultivation or the grasses are otherwise destroyed, drifting sand usually covers the vegetation over a much larger area than the one originally disturbed.

SOILS AND THEIR INTERPRETATION

The soils of Dundy County have developed in a rather uniformly dry climate but under variable drainage and over a wide range of parent soil materials and surface relief. They have also formed under a grass cover which varies considerably in density and character, according to drainage conditions.

Throughout approximately the eastern third of the county and in the area south of Republican River, the greater part of the land is mantled, either in situ or otherwise, by a uniformly light gray limy floury silt identified by the Nebraskan geologists as Peorian loess. In about one half of this area the loessial mantle has been rather thoroughly dissected by the Republican River and its tributaries, and the relief in detail is rough. The least dissected loess-covered sections are in the northeastern and southeastern parts of the county, where the land surface over large areas is either nearly level or gently undulating. Rather large nearly level areas also occur in the east-central part.

Most of the rest of the county is covered by gray or grayish-brown fine sand or medium sand, composed largely of quartz particles, probably released from light-colored limy sandstones of late Tertiary Age. Sandstone outcrops occur in several places throughout the sandy area. Wind action on the incoherent sand has produced a succession of irregularly distributed hills, ridges, and knolls interspersed at frequent intervals with pockets and enclosed valleys of various sizes and shapes.

The effectiveness of the chief soil-forming agents, climate and vegetation, in transforming the parent materials into soil is not equally expressed on such widely different materials as sand and loess. Their effectiveness is not everywhere equally expressed even within areas wholly occupied by sand or by loess, because of differences in the surface relief, drainage, and vegetal cover from place to place.

In the sand-covered parts of the county, most of the soils have developed under a tall-grass vegetation composed chiefly of Andropogon, Calamovilfa, and Stipa. These grasses have large root systems, but except in moist situations their growth is sparse, their roots decay slowly, and most of the decomposed vegetal material is removed from the rather unstable sand during periods of dry windy weather. In consequence the greater part of the sandy soils is light colored, on account of a scarcity of organic matter. The loose porous sands have facilitated rapid downward percolation of moisture, and the more extensive sandy soils are thoroughly leached of their carbonates. However, not all the soils developed within the sandy areas are light colored and low in lime. Those occupying the numerous, though usually small, depressions and long gradual slopes, where seepage water from higher levels stabilizes the sand and promotes vegetal growth and decay, have fairly dark, in some places almost black, topsoils. Most of the soils in these localities are also well supplied with lime; in fact, those in the more poorly drained basins throughout the sand-covered parts of the county react slightly alkaline in spots, owing to an accumulation of salts carried in by seepage from higher lying areas.

The quartzitic sand, of which most of the soils throughout the sand-covered section are so largely composed, is extremely resistant to weathering, and none of the soils formed on this material has acquired definite zones or layers characteristic of mature development. The more extensive areas consist simply of incoherent sand, the topmost few inches of which have been more or less darkened by organic matter. Some of the less extensive bodies contain sufficient silt washed or blown in from loessial areas to give them considerable stability, especially in the topsoils, but they have not developed a zonal profile.

In the loess-covered sections, most of the soils have developed under a short-grass vegetation, chiefly Bouteloua and Bulbilis. These grasses have smaller root systems than the tall-grass species of the sandy lands, but they grow much denser. Their roots thoroughly mat the soil to a depth ranging from 6 to 10 inches and on decaying produce more organic matter than is produced in the sandy lands by the sparser growing tall-grass species. Most of the organic material is retained in the upper foot or so of the loess-derived soils, and these soils, except where subject to considerable water erosion, have darker surface layers than commonly occur in the soils of the sand-covered area. However, large areas of the loessial mantle in Dundy County are so severely eroded that the grass cover is poorly established or absent. Such areas occur chiefly on the steeper valley slopes and around the heads of drainageways. They are extensively developed on both sides of Republican River in the southern part of the county. Here, the loessial material has not made much progress toward the formation of soil. In many places the unweathered limy loess is exposed, and the colors of the soils range from nearly white to spotted light and dark, the proportion of each color in a particular locality depending on the severity of erosion.

Aside from those in small poorly drained depressions, none of the loess-derived soils has been leached of its lime or has developed any layer of unusual compaction in its profile. In the more nearly level but well-drained areas the carbonates have been removed from the surface soils but have accumulated in the subsoils, creating a zone of higher lime carbonate content than occurs in any other part of the soil profile or in the underlying loess. In many places, the eroded loess-derived soils are calcareous from the surface downward but contain no zone of carbonate concentration.

The soils in poorly drained depressions throughout the more nearly level loess-covered uplands have been subjected to unusually large quantities of water and have been thoroughly leached of their lime carbonate. Their topsoils are in general thin and their subsoils dense and claypanlike.

The bottom-land soils have developed from loess, sand, or loess-sand mixtures which have been deposited as sediments in the stream valleys. Most of the sediments are of rather recent origin, and the soils developed from them are in general low in organic matter and light in color.

The soils of Dundy County have been grouped in this report into 13 soil series, namely, Keith, Colby, Rosebud, Canyon, Dawes, Scott, Anselmo, Valentine, Gannett, Bridgeport, Tripp, Laurel, and Sarpy. In addition, dune sand, which is not regarded as a soil, is recognized.

Soils of the first nine series named and dune sand occupy upland positions. The Tripp and Bridgeport soils are on terraces, although some of the Bridgeport areas may occupy long colluvial slopes. The Laurel and Sarpy soils are on the flood plains.

The Keith and Tripp soils have been formed under conditions especially favorable for deep soil weathering and the accumulation of organic matter. They occupy nearly level or undulating loessial areas, have developed under good but not excessive surface drainage and underdrainage, and have lain in their present positions practically undisturbed by wind or water erosion for a long time. These soils have reached a stage of development beyond that of any other well-drained soil in the county, and they seem to have attained maturity, as governed by the regional climate and the vegetation under which they were formed. They are very similar to one another, and the following description of a profile of Keith silt loam, examined on the nearly level loess-covered plain north of Republican River in Calvert Township, may be regarded as typical of all maturely developed soils in Dundy County.

From 0 to one half inch, grayish-brown single-grain silt loam which is dustlike when dry.

From one half to 6 inches, dark chestnut-brown friable silt loam. The upper 2½ inches of this layer have a distinctly laminated or platy structure, and the remainder is structureless.

From 6 to 16 inches, chestnut-brown or grayish-brown silt loam which, although apparently structureless, has a more mealy and less dustlike appearance than the topmost layer. This is the layer of maximum density, but the increased compaction is not noticeable, except through a comparison of all layers in the soil profile. The material breaks readily into soft clods of irregular sizes and shapes.

From 16 to 48 inches, very light grayish-brown friable silt containing an abundance of lime in disseminated form, as coatings on the surfaces of clods and as soft fillings in seams and cracks. The coatings and fillings become less noticeable with depth, and the layer merges gradually into the underlying unweathered loess which, although very limy, contains very few spots of carbonate segregation.

The color transitions between the different layers are gradual. The third layer contains numerous worm casts, and both this layer and the fourth have many root, worm, or insect holes which have become filled with soil material of a slightly lighter or darker shade than characterizes the surrounding matrix. In the upper three layers no noticeable swelling or effervescence occurs when dilute hydrochloric acid is applied. Below these layers all the material effervesces freely with acid, but the most vigorous reaction occurs in the fourth layer which is apparently the one of maximum carbonate enrichment.

Associated with Keith silt loam throughout the loessial uplands are several other Keith soils including a very fine sandy loam, a fine sandy loam, a deep phase of the silt loam, and a slope phase of the silt loam. These soils and phases, although similar in their major characteristics to Keith silt loam, differ sufficiently from that soil and from one another in minor features to warrant their recognition on the soil map. Areas of Keith very fine sandy loam and Keith fine sandy loam in general lie nearer sandy soil areas than do areas of Keith silt loam, and the soils have accumulated slightly larger quantities of wind-blown sand in their topsoils, the fine sandy loam containing a little more and coarser sand than the other Keith soils. The deep phase of Keith silt loam occupies slightly depressed situa-

tions, into which more or less material has been washed or blown, producing a somewhat thicker and coarser textured topsoil than typical. The slope phase of Keith silt loam occupies sloping positions where surface run-off has caused a slightly thinner topsoil than occurs in the more nearly level areas.

The Colby soils have developed from gray limy loess similar to that underlying the Keith soils. They occupy steep valley slopes and sharp ridge crests and have been subjected to excessive erosion. The rapid surface run-off has prevented the accumulation of much organic matter and has not allowed leaching of the carbonates as fast as new material has been exposed at the surface. Lime, therefore, is abundant and evenly distributed from the surface downward. The soils are very light in color and have not developed definite zones, or layers, such as occur in the Keith soils. In most places they consist of loess exposures, the topmost few inches of which have been only slightly modified by weathering and the accumulation of organic matter. Colby silt loam, Colby very fine sandy loam, and a broken phase of Colby silt loam are recognized.

Scott silt loam is the most poorly drained of the loess-derived soils in Dundy County. It occupies small basinlike depressions, most of which are surrounded by areas of Keith silt loam. Water collects in the basins after heavy rains and remains on the surface of the ground until removed by absorption or evaporation. The topsoil in few places exceeds 8 inches in thickness. It ranges in texture from silt loam to silty clay loam and is in most places moderately compact. The material varies considerably in structure but is in most places more or less laminated and in few places contains any granular material. The color in the upper part of the layer is nearly black, and in the lower part may or may not be dark. This soil in most places is more or less leached, and in the more poorly drained localities much of it is gray or almost white.

The subsoil, which continues to a depth ranging from 5 to 6 feet, is a true claypan, being composed of heavy structureless clay or silty clay. It ranges from dark grayish brown to gray or lead colored—the darker shades being confined to the upper part—and contains numerous ferruginous stains, streaks, and splotches. Beneath the claypan is the light-gray floury Peorian loess from which the soil has weathered. The excessive moisture has removed all traces of lime carbonate to a depth ranging from 7 to more than 8 feet.

The dense claypanlike layer in this soil is the result, in part at least, of translocation of clay from the surface soil by percolating waters. Sodium or potassium salts may have contributed to its formation or may even have been the chief factor. However, no analytical data are available for the Scott soil in Dundy County, and no definite statement can be made regarding the origin of the claypan. The soil does not appear to be alkaline.

The Rosebud soils have weathered in situ from a light-gray loosely indurated and calcareous sandstone of late Tertiary Age. They occur in small bodies throughout the more sandy parts of the county, wherever the sandstone has not been deeply covered with windblown sands and has weathered long enough to have developed soils with distinguishable topsoil and subsoil layers. The tertiary sand-

stone is extremely resistant to weathering, and none of the Rosebud soils is maturely developed. However, those areas occupying well-drained situations have made considerable progress toward maturity. The surface soil, which extends to an average depth of 12 inches, is friable throughout and has accumulated sufficient organic matter to give it a dark grayish-brown or chestnut-brown color. The subsoil is a uniformly light gray friable very fine sandy loam. It has a fairly well developed zone of lime carbonate enrichment, which begins at an average depth of 24 inches and extends to a depth ranging from 3 to 4 feet, where it rests on the parent sandstone. Aside from the rather dark surface soil and the zone of lime carbonate enrichment, these soils have no layers comparable to those in Keith silt loam.

In poorly drained situations, such as enclosed valleys and pockets, the Rosebud soils have accumulated unusually large quantities of organic material in the topsoils, these layers being very dark, in many places almost black. The subsoils, which are slightly heavier than the topsoils, are very light colored throughout. They consist of fine sandy loam or very fine sandy loam with a high calcium carbonate content, but they are almost continually saturated and in some places have developed sticky greenish- or bluish-gray gleilike layers 6 or 8 inches thick at a depth ranging from 3 to 4 feet. The gleilike layers are composed largely of clay and very fine sand and may either rest directly on the parent tertiary sandstone or be separated from it by a few inches of loose gray sand. The lime carbonate, so abundant throughout the subsoil, appears to be uniformly distributed.

The Dawes soils have developed from fine-textured material of either loessial or tertiary origin. They occupy numerous, though usually small and shallow, basins occurring chiefly in the sand-covered parts of the county. The basins have no surface drainage outlets. They are somewhat similar to those in which the Scott soils occur but do not appear to have received such large quantities of water or to have been subjected to excess water so continuously as the basins occupied by the Scott soils. The Dawes soils have accumulated considerable organic matter and have very dark surface layers. The soil material, to a depth of 14 or 16 inches, resembles the material at a corresponding depth in Keith silt loam, except it is a little coarser and darker. The upper part of the subsoil, extending to a depth of about 30 inches, is much more compact than any layer of the Keith soils. However, it is not nearly so dense and claypanlike as the subsoil layer in the Scott soils and is much better oxidized and browner than that layer. It is underlain by a layer of loose very fine sandy loam or silt loam, in which an abundance of finely disseminated calcium carbonate has accumulated. This lower layer is very similar to the zone of carbonate enrichment so characteristic of the Keith soils but which nowhere occurs in Scott silt loam. The material beneath the carbonate layer may be loesslike or composed of loose gray sand, there apparently being no uniformity in the underlying deposit. It is invariably calcareous but less so than the overlying layer.

The Anselmo soils have developed from mixtures of calcareous sand and silt, which occupy numerous though generally small rolling

or nearly level areas throughout the sandy uplands in the central and western parts of the county. The origin and rather spotted occurrence of the silt and sand mixtures are not clearly understood. In most places the silt is most abundant in the upper 2 or 3 feet of the otherwise very sandy material, but in few places does it comprise more than 15 or 20 percent of the soil mass at any depth. It may represent loessial residue which became mixed with the sand during the removal of an overlying loessial deposit or it may have been released from more distant loessial or fine-textured tertiary materials and distributed by the wind. In either case it was probably deposited rather evenly over the sandy lands. Its seemingly spotted occurrence at present may be on account of its having been covered or otherwise obscured by wind-blown sands over the greater part of its original distribution.

The soils which have developed on these sand and silt mixtures are more stable, more calcareous, and have slightly darker surface layers than any of the surrounding areas of Valentine soils or dune sand. However, all of them are rather light in color, and none has developed definite zones or layers.

In most places the soil material consists of light-gray fine sandy loam or loamy sand, the 6- or 8-inch surface layer of which is grayish brown or dark grayish brown, owing to the addition of organic matter. The soil in a particular profile is remarkably uniform in texture to a depth ranging from 3 to 4 feet, but from place to place the texture differs considerably, depending on variations in the relative proportions of sand and silt in the parent material.

The carbonates in most places have been leached from the topsoil but are abundant below a depth ranging from 24 to 30 inches, where they occur in finely disseminated form uniformly mixed with the mineral soil material.

The Anselmo soils are very similar to the Bridgeport soils, but they occur in the uplands and for this reason are not included with the Bridgeport soils.

The Valentine soils and dune sand are composed almost entirely of loose gray quartzitic sand which is extremely resistant to weathering and is rather unstable. The soils developed from this sand are light colored throughout, owing to a scarcity of organic matter. In addition they have been entirely leached of their carbonates except locally, where they receive lime in the drainage waters from higher lying loessial soils. The Valentine soils are developed in the less wind-whipped localities and have gently rolling or hummocky surfaces, whereas the dune sand areas are hilly.

The Bridgeport soils are developed on terraces and very gradual colluvial slopes in the larger stream valleys. They have formed under conditions of good surface drainage and underdrainage but from materials of rather recent accumulation, and sufficient time has not elapsed for the development of zones or layers of true soil character. The surface layer, to a depth of 8 or 10 inches, is in most places considerably darker than the remainder of the soil, but in few places is it as dark as the corresponding layer in the Keith or Tripp soils. The underlying material, to a depth exceeding 4 feet, is light grayish brown or almost white. It has no structure and is friable throughout. The texture of the soil material throughout,

although nearly uniform in a particular spot, differs widely in different localities. The soil is highly calcareous below a depth of 12 or 14 inches, but there is no zone of unusual concentration or segregation of the carbonates as in the Keith and Tripp soils.

SUMMARY

Dundy County is in the southwestern corner of Nebraska. It is rectangular in shape and comprises 920 square miles, or 588,800 acres.

The county includes parts of two major physiographic regions of the State—a smooth eastwardly sloping plain which roughly occupies the eastern third and also includes a narrow strip along the southern edge, and a valley plain which occupies the remainder. In the former surface irregularities have been produced largely by stream erosion, and aside from the alluvial lands the most nearly level areas are on high uneroded tables in the northeastern and southeastern parts of the county. The roughest parts of this region are on valley slopes along Republican and Arikaree Rivers and the larger creeks, where the rapid run-off of surface water has produced an extremely rough and broken relief in many places.

The surface features in the valley plain region are largely the result of wind action. The most nearly level land occupies numerous swales, valleys, and pockets of various sizes and shapes, and the more rolling and hilly areas are in the higher situations. Over most of this region the loose incoherent sands have been piled into dunes ranging in height from 10 to about 100 feet.

The average elevation of the county is about 3,350 feet above sea level, and the range in elevation is about 630 feet.

Dundy County was established and organized in 1873. Most of the early settlers came from States to the east. The population, according to the Federal census, was 5,610 in 1930 and the density of the population 6.1 persons a square mile.

Transportation facilities are fair. The main line of the Chicago, Burlington & Quincy Railroad and a gravel-surfaced State highway cross the county from east to west. The county roads are of earth construction but except in the rougher and more sandy sections are kept in good repair.

There are 63 public-school districts in the county. Telephones are in common use, and mail routes reach nearly all parts.

The climate is characterized by wide variations in temperature and rather low precipitation. The mean annual temperature at Benkelman is 50.8° F. and the mean annual precipitation is 19.77 inches. The rainfall in early summer is usually well distributed, but in July and August the distribution is less favorable and droughts often occur.

Dundy County is essentially agricultural. According to the Federal census, about 32 percent of the total land area is under cultivation and about 57 percent is in pasture land. The leading grain and tame-hay crops are corn, wheat, alfalfa, barley, rye, and oats, ranking in acreage during most years in the order named. The Federal census reports the value of all crops produced in the county in 1929 to be $2,666,104 and the total value of all domestic animals

on farms April 1, 1930, to be $1,897,264. Cattle raising is practiced extensively, chiefly because of the large acreage in pasture land.

The average size of the farms is 751.6 acres, although there are a number of smaller holdings and many ranches exceeding 1,000 acres.

In general, farm laborers are plentiful. Combines are used rather extensively in harvesting the wheat crop.

Cattle and hogs are the chief sources of revenue, and practically all the corn, oats, and alfalfa produced is used in raising and fattening these animals. Wheat, the chief cash crop, is usually sold as soon as it is harvested. The principal cattle and wheat markets are Omaha and Kansas City, and most of the hogs are shipped to Denver or more western points.

There are 25 soil types and 4 phases of types, in addition to dune sand, recognized in Dundy County. These are classed in this report, according to the crops which are most extensively grown on them and for which they seem to be best suited, into four broad groups, namely, general-farming soils; corn, rye, and sweetclover soils; corn and alfalfa soils; and native pasture and hay soils.

The general-farming soils occupy about 80 percent of the cultivated land. They include the Keith, Dawes, and Tripp soils; the finer-textured Bridgeport soils; and the better drained Rosebud soils, all of which are composed largely of silt. These soils are well drained, have nearly level or gently rolling surfaces, and are friable throughout. They have all accumulated considerable organic matter and have dark-colored topsoils. They are stable under cultivation. The Keith, Dawes, and Rosebud soils occupy upland positions, and the Tripp and Bridgeport are on terraces or terracelike colluvial slopes. None of these soils gives as high yields, especially of corn and alfalfa, as the best bottom-land soils, but all are adapted to a wider variety of crops than the bottom-land soils and produce higher and more uniform yields of all crops commonly grown in the county than any upland or terrace soil not belonging to the group. Keith silt loam is the most extensive cultivated soil in the county.

The corn, rye, and sweetclover soils occupy 8.4 percent of the cultivated land. They include the Anselmo soils and a coarse-textured Bridgeport soil, all of which are composed largely of sand. The Anselmo soils occupy numerous, though usually small, areas throughout the sand-hill section, and the Bridgeport soil is on long colluvial slopes in the Republican River Valley. These soils contain less organic matter and are a little lighter in color than the soils of the general-farming group. They are also more droughty than those soils, largely on account of their higher sand content. They are not well adapted to wheat, oats, barley, or alfalfa, but they produce fair yields of corn, rye, and sweetclover in all except the driest years and are used chiefly for these crops. None of them is so stable as the more silty soils of the county. However, they contain sufficient silt mixed with the sand to give them considerable coherence and to prevent excessive drifting.

Soils of the corn and alfalfa group occupy only 32.8 square miles. They occur in the bottom lands along the rivers and larger creeks and are well supplied with moisture. They include 1 Laurel and 3 Sarpy soils. These soils are rather low in organic matter and are consequently light in color. Owing to their high moisture supply,

they are not well adapted to small-grain crops. However, they are the most productive corn and alfalfa soils in the county, and practically all the area occupied by them is used for these crops.

The soils classed in the native pasture and hay group occupy more than 50 percent of the total land area. They include dune sand; the Colby, Valentine, Canyon, Scott, and Gannett soils; and a poorly drained phase of a Rosebud soil. One or another of these occur wherever the land is too rough or too poorly drained for cultivation or where the soil is too thin, unstable, or droughty to be used for grain or tame-hay crops. Dune sand, the Valentine soils, and the Colby soils are the most extensive. The first two named are composed almost entirely of sand and are rather droughty and unstable. The Colby soils are composed of silt, but they are very severely eroded. The Scott, Gannett, and poorly drained Rosebud soil are the only soils of the group which have acumulated much organic matter. However, as they occupy very poorly drained depressions, they cannot be used for grain or tame-hay crops. The greater part of the soils belonging to this group is included in native pasture or hay land.

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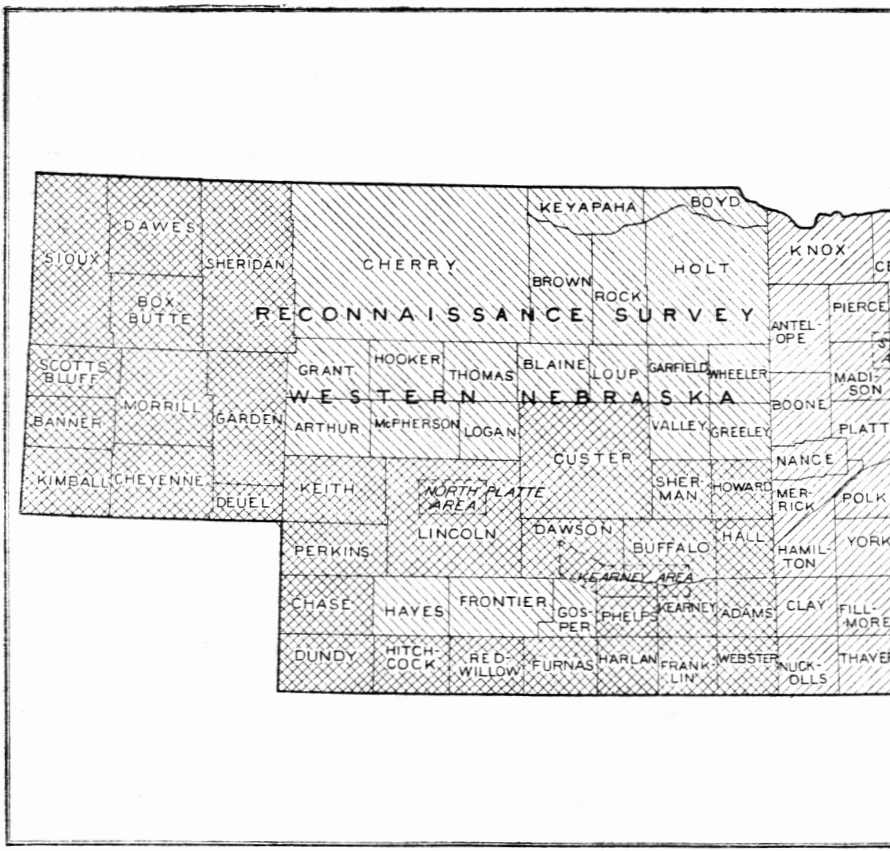
Authority for printing soil survey reports in this form is carried in Public Act No. 269, Seventy-second Congress, second session, making appropriations for the Department of Agriculture, as follows:

There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than two hundred and fifty copies shall be for the use of each Senator from the State and not more than one thousand copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.



Areas surveyed in Nebraska, shown by shading.

Detailed surveys shown by northeast-southwest hatching; reconnaissance surveys shown by n
crosshatching indicates areas covered in both ways.

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CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP
DUNDY COUNTY
NEBRASKA

UNIVERSITY OF NEBRASKA
STATE SOIL SURVEY DEPARTMENT OF THE
CONSERVATION AND SURVEY DIVISION
G. E. CONDRA, DEAN AND DIRECTOR


LEGEND
Anselmo loamy sand
Keith silt loam
Anselmo fine sandy loam
Slope phase
Bridgeport loamy fine sand
Deep phase
Bridgeport fine sandy loam
Laurel very fine sandy loam
Bridgeport very fine sandy loam
Rosebud sandy loam
Bridgeport silt loam
Poorly drained phase
Canyon sandy loam
Sarpy loamy sand
Colby very fine sandy loam
Sarpy fine sandy loam
Colby silt loam
Sarpy silt loam
Scott silt loam
Broken phase
Dawes sandy loam
Tripp very fine sandy loam
Dawes very fine sandy loam
Valentine sand
Gannett loamy sand
Valentine loamy sand
Keith fine sandy loam
Valentine fine sandy loam
Keith very fine sandy loam
Dune sand
CONVENTIONAL SIGNS
HARRISON
THAYER
LUTZ
HOOVER
MUDDY
ALLSTON
UNION
INDIAN CREEK
HAIGLER
PARKS
BENKELMAN
MAX
Haigler
Benkelman
Max
REPUBLICAN
RIVER
R. 42 W.
R. 41 W.
R. 40 W.
R. 39 W.
R. 38 W.
R. 37 W.
R. 36 W.
CHASE CO.
DUNDY CO.
HAYES CO.
CHEYENNE CO.
RAWLINS CO.
NEBRASKA
KANSAS
BOUNDARY LINE

Thomas D. Rice, Inspector, District 3.
Soils surveyed by E. A. Nieschmidt, in charge, and B. J. Abashkin, Nebraska Soil Survey, and F. A. Hayes and S. Rankin Bacon, U. S. Department of Agriculture.

Scale 1 inch-1 mile

Field Operations
Bureau of Chemistry and Soils
1931